Planning and Environmental Consultants

Environmental Impact Assessment Report

Briskalagh Renewable Energy Development, Co. Kilkenny

Chapter 5 – Population and Human Health

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5. POPULATION AND HUMAN HEALTH

5.1 Introduction

This section of the Environmental Impact Assessment Report (EIAR) identifies, describes and assesses the potential effects of the Proposed Project on population and human health and has been completed in accordance with the Environmental Impact Assessment (EIA) guidance and legislation set out in Chapter 1: Introduction. The full description of the Proposed Project is provided in Chapter 4 of this EIAR.

As detailed in Section 1.1.1 in Chapter 1, for the purposes of this EIAR, the various project components are described and assessed using the following references: 'Proposed Project', 'Proposed Wind Farm', 'Proposed Grid Connection' and the 'Site'.

One of the principal concerns during the development process is that human beings, as individuals or communities, should experience no significant diminution of their quality of life from the direct, indirect or cumulative effects arising from the construction, operation and decommissioning of a development. Ultimately, all the effects of a development impinge on human beings, directly and indirectly, positively and negatively. The key issues examined in this chapter of the EIAR include population, human health, employment and economic activity, land use, residential amenity (including visual amenity, shadow flicker and noise), community facilities and services, tourism, property values, traffic and health and safety.

5.1.1 Statement of Authority

This section of the EIAR, has been prepared by Jack Smith and reviewed by Eoin McCarthy, of MKO. Jack is a Project Environmental Scientist with MKO with over 3 years' experience in the consultancy sector. Jack holds a MSc. in Environmental Leadership from NUIG and is a Practitioner member of the Institute for Environmental Management and Assessment. Jack's key strengths and areas of expertise are in project management, environmental impact assessment, GIS mapping and modelling, and feasibility assessment. Since joining MKO, Jack has experience in report writing including feasibility studies and EIA screening reports and EIAR chapters including Population and Human Health chapters for large-scale renewable energy developments. Eoin McCarthy holds a BSc. (Env.) in Environmental Science and is a Project Director with over 13 years' experience in the consultancy sector. Eoin has completed numerous Population and Human Health sections of EIARs for wind farm developments. This chapter was also reviewed by Michael Watson. Michael Watson is Director of Environment at MKO with over 20 years' experience in the environmental sector.

5.1.2 Relevant Guidelines and Data Sources

In addition to the guidelines referred to in Section 1.2.1 and Section 1.2.2 of Chapter 1 of this EIAR, and Directive 2011/92/EU as amended by Directive 2014/52/EU, the following guidelines, plans and reports have also influenced the preparation of this chapter:

- Department of Health – Health in Ireland: Key Trends 2022;
- Environmental Impact Assessment of National Road Schemes- A practical Guide, National Roads Authority/ Transport Infrastructure Ireland, Revision 1, November 2008;
- Fáilte Ireland EIAR Guidelines for the Consideration of Tourism and Tourism Related Projects, July 2023.
- Health Impact Assessment Resource and Tool Compilation, United States Environmental Protection Agency 2016;
- Health Impact Assessment Guidance, Institute of Public Health Ireland. 2009;

- Framework for Human Health Risk Assessment to Inform Decision Making developed by the United States Environmental Protection Agency (US EPA) 2014;
- Institute for Environmental Management and Assessment (2017) Health In Environmental Impact Assessment: A Primer for a Proportionate Assessment;
- Institute for Environmental Management and Assessment (2022) Determining Significance for Human Health in Environmental Impact Assessment;
- Central Statistics Office (CSO): Census of Ireland 2016; Census of Ireland 2022; Census of Agriculture 2020;
- Kilkenny County Development Plan 2021-2027;
- The World Health Organisation (WHO) Environmental Noise Guidelines for the European Region (WHO, 2022 Update) https://www.who.int/
- Best Practice Guidelines for the Irish Wind Energy Industry, IWEA, 2012.

5.1.3 Scoping

Chapter 2 of this EIAR describes the scoping and consultation exercise undertaken for the Proposed Project. Relevant to this chapter, responses were received from the Health Service Executive (HSE), Irish Water & Fáilte Ireland.

Health Service Executive

A scoping response was received from the Health Service Executive (HSE) on 5th January 2024. The HSE requested a shadow flicker assessment is undertaken to identify any sensitive receptors which may be impacted by shadow flicker and noted that the environmental impact assessment must include all proposed mitigation measures, including air quality due to the nature of the proposed construction works generation of airborne dust has the potential to have significant impacts on "*sensitive receptors*". The response stated that a Construction Environmental Management Plan (CEMP) should be included in the EIAR which details dust control and mitigation measures. The HSE further stated that the EIAR should examine all likely significant impacts and provide the following information for each:

- Description of the receiving environment;
- The nature and scale of the impact;
- An assessment of the significance of the impact;
- Proposed mitigation measures;
- Residual impacts.

Directive 2014/52/EU has an enhanced requirement to assess likely significant impacts on Population and Human Health. It is the experience of the Environmental Health Service (EHS) that impacts on human health are often inadequately assessed in EIAs in Ireland. It is recommended that the wider determinants of health and wellbeing are considered in a proportionate manner when considering the EIA. Guidance on wider determinants of health can be found at www.publichealth.ie

The HSE advised that in addition to any likely significant negative impacts from the Proposed Project, any positive likely significant impacts should also be assessed.

The Environmental Health Service (EHS) recommends that the following matters are included and assessed in the EIAR:

- Public Consultation
- Decommissioning phase of the proposed wind farm
- Siting and location of turbines
- Noise & Vibration
- Shadow Flicker
- Air Quality

- Surface and Groundwater Quality
- Geological Impacts
- Ancillary facilities
- Cumulative impacts

Impacts from shadow flicker are assessed in Section 5.9 and 5.10.3.2.7. An assessment of effects on human health as a result of impacts to air quality are assessed in Section 5.10 and in more detail within Chapter 10 Air Quality. An assessment of effects on human health as a result of impacts to water quality are assessed in Section 5.10 and in more detail within Chapter 9 Hydrology and Hydrogeology. An assessment of effects on human health as a result of impacts from noise and vibration are assessed in Section 5.10 and in more detail within Chapter 11 Noise and Vibration.

Irish Water

Irish Water provided a response to a scoping request on the 12th December 2023, outlining the measures for consideration in the scope of an Environmental Impact Assessment (EIA). This includes steps to avoid any adverse effects on Irish Water's Drinking Water Source(s) during both the construction and operational phases of the development, as well as an assessment of potential impacts on nearby public water supply infrastructure. Impacts on utilities including Irish Water infrastructure are assessed in Chapter 15 Material Assets.

Fáilte Ireland

A scoping response was received from Fáilte Ireland on the 6th of December 2023 and provided the 'Fáilte Ireland's Guidelines for the Treatment of Tourism in an EIA', to inform the preparation of the EIAR for the Proposed Project. The report provides guidance for those conducting Environmental Impact Assessment and compiling an Environmental Impact Assessment Report (EIAR), or those assessing EIARs, where the project involves tourism or may have an impact upon tourism (see Section 5.4 and Section 5.10.3.1.5 for further detail).

5.2 Assessment Methodology

5.2.1 Population

A desk-based assessment using sources and guidelines referenced in Section 5.1.2 above was undertaken to examine relevant information pertaining to the population impact assessment. Information on population statistics, employment and social data for the relevant Electoral Divisions (EDs) were obtained from the Central Statistics Office (CSO) for census years 2016 and 2022. Fáilte Ireland's EIAR Guidelines for the Consideration of Tourism and Tourism Related Projects was also considered in this assessment. See Section 5.3 below.

In order to assess the population in the vicinity of the Proposed Wind Farm, the Population Study Area for this population assessment focuses on the EDs within which the Proposed Wind Farm site is within and adjacent to, namely Ballycallan, Kilmanagh, and Tullaroan, but it also refers to county and national statistics.

In order to assess the population in the vicinity of the Proposed Grid Connection, a review of properties and planning applications in the vicinity of the underground electrical cabling route was carried out. There are 252 no. properties located within 100m of the Proposed Grid Connection underground cable route.

The active construction area for the Proposed Grid Connection underground cable route will be small, ranging from 100 to 150 metres in length at any one time, and it will be transient in nature as it moves along the route. Should separate crews be used during the construction phase they will generally be separated by one to two kilometres.

5.2.2 Human Health

This human health analysis section was assessed using guidelines set out in Section 5.1.2 above.

The World Health Organisation (WHO) defines health as:

> "*A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*".[4]

5.2.2.1 National Guidance

The EPA 2022 EIAR Guidelines advise that "*in an EIAR, the assessment of impacts on population and human health should refer to the assessments of those factors under which human health effects might occur, as addressed elsewhere in this EIAR e.g., under the environmental factors of air, water, soil etc.*" Environmental impacts from the Proposed Project which may also have an impact on population and human health are discussed in this chapter but addressed in more detail in the following chapters: Chapter 8 Land Soil and Geology, Chapter 9 Hydrology and Hydrogeology, Chapter 10 Air Quality, Chapter 11 Climate, Chapter 12 Noise and Vibration, Chapter 14 Landscape and Visual, Chapter 15 Material Assets (including Traffic and Transport).

As referenced in the Department of Housing, Planning and Local Government (2018) *Guidelines for Planning Authorities and An Bord Pleanála*, (taken from the European Commission's Environmental Impact Assessment of Projects: Guidance on the Preparation of the Environmental Impact Assessment Report (2017)), human health is, "*a very broad factor that would be highly project dependent.*" The report continues:

> '* *The notion of human health should be considered in the context of the other factors in Article 3(1) of the EIA Directive and thus environmentally related health issues (such as health effects caused by the release of toxic substances to the environment, health risks arising from major hazards associated with the Project, effects caused by changes in disease vectors caused by the Project, changes in living conditions, effects on vulnerable groups, exposure to traffic noise or air pollutants) are obvious aspects to study. In addition, these would concern the commissioning, operation, and decommissioning of a Project in relation to workers on the Project and surrounding population.*'

The EIAR Guidance (EPA, 2022) also states that "*while no specific guidance on the meaning of the term Human Health has been issued in the context of Directive 2014/52/EU, the same term was used in 3.3.6 the SEA Directive (2001/42/EC). The Commission's SEA Implementation Guidance states 'The notion of human health should be considered in the context of the other issues mentioned in paragraph (f)'*" of the Directive, where paragraph f lists environmental factors such as soils, water, landscape, air etc. The EIAR Guidelines (EPA, 2022) state that this approach is '*consistent with the approach set out in the 2002 EPA Guidelines where health was considered through assessment of the environmental pathways through which it could be affected, such as air, water or soil*'. The EIAR Guidelines (EPA, 2022) note that the above approach follows the 2002 EPA guidelines already in place which details the following:

> *'The evaluation of effects on these pathways is carried out by reference to accepted standards (usually international) of safety in dose, exposure or risk. These standards are in turn based upon medical and scientific investigation of the direct effects on health of the individual substance, effect or risk. This practice of reliance upon limits, doses and thresholds for environmental pathways, such as air, water or soil, provides robust and reliable health protectors [protection criteria] for analysis relating to the environment'.*

5.2.2.2 IEMA Guidance 2017

The Institute for Environmental Management and Assessment (IEMA) published 'Health In Environmental Impact Assessment: A Primer for a Proportionate Assessment' in 2017 examining what a proportionate assessment of the impacts on health should be in Environmental Impact Assessments. The document states that Health Impact Assessment (HIA) and EIA are separate processes.

> *'HIA is defined as a combination of procedures, methods and tools that systematically judges the potential, and sometimes unintended, effects of a policy, plan, programme or project on both the health of a population and the distribution of those effects within the population. HIA identifies appropriate actions to manage those effects… […] … HIA can inform EIA practice in relation to population and human health but conducting a HIA will not necessarily meet the EIA population and human health requirement. By the same token, conducting an EIA will not automatically meet the requirements of a HIA.'*

The Primer Assessment Report acknowledges that *'disproportionate burdens may be placed on developers if HIA is applied as a proxy for the consideration of population and human health in every future UK EIA'.* The focus of EIA should be on predicting health and wellbeing outcomes, rather than focusing on changes in determinants of health e.g., expected changes in noise levels. Determining the significance of impacts on population and human health should include a professional judgement, scientific literature; consultation responses; comparison with baseline conditions; local health priorities; and national/international regulatory standards and guidelines. The primer report refers to the WHO 2014 which provides and overview of health in different types of assessment:

> *"The health sector, by crafting and promoting HIA, can be regarded as contributing to fragmentation among impact assessments. Health issues can, and need to, be included [in impact assessment] irrespective of levels of integration. At the same time, from a civic society perspective, it would be unacceptable for HIA to weaken other impact assessments. A prudent attitude suggests optimizing the coverage of health along all three avenues:*
>
> - *better consideration of health in existing impact assessments other than HIA;*
> - *dedicated HIA;*
> - *and integrated forms of impact assessment."*

As such, the WHO does not support a stand-alone HIA unless it could be demonstrated to be of advantage over an EIAR. Therefore, given that this human health assessment is part of the EIAR; there is no stand-alone HIA.

5.2.2.3 EIA Significance Matrix for Human Health, IEMA Guidance 2022

The IEMA Working Group 2022 published *Determining Significance For Human Health In Environmental Impact Assessment* in response to gaps and inconsistencies across existing guidance documents as to how health is assessed in EIA, particularly with regard to significance. The aim of this report is to assist and streamline discussions for consultants producing the assessments and for the decision makers who are reviewing the assessments. The report states that an EIA must identify, describe and assess the direct and indirect significant effects in an appropriate manner of a proposed development on human health. It must include the information that may reasonably be required for reaching a reasoned conclusion on the significant effects, taking into account current knowledge and methods of assessment.

A wind farm is not a recognised source of pollution. It is not an activity which requires Environmental Protection Agency licensing under the Environmental Protection Agency Act 1992, as amended. As such, a wind farm is not considered to have ongoing significant emissions to environmental media and the subsequent potential for human health effects. In this context, and aligned with the above noted

IEMA Guidance, this EIAR provides sufficient information that may reasonably be required for reaching a reasoned conclusion on the significance of effects, without providing the level of detail, for example through the use of the significance matrix set out in the IEMA Guidance, which might be required for an assessment of effects on human health arising from a type of development with a potential for emissions-related human health effects.

5.2.3 Shadow Flicker

5.2.3.1 Background

Shadow flicker is an effect that occurs when rotating wind turbine blades cast shadows over a window in a nearby property. Shadow flicker is an indoor phenomenon, which may be experienced by an occupant sitting in an enclosed room when sunlight reaching the window is momentarily interrupted by a shadow of a wind turbine's blade. Outside in the open, light reaches a viewer (person) from a much less focused source than it would through a window of an enclosed room, and therefore shadow flicker assessments are typically undertaken for the nearby adjacent properties around a proposed wind farm site.

The frequency of occurrence and the strength of any potential shadow flicker effect depends on several factors, each of which is outlined below.

1. ***Whether the sunlight is direct and unobstructed or diffused by clouds:***

If the sun is not shining, shadow flicker cannot occur. Reduced visibility conditions such as clouds, haze, and fog greatly reduce the chance of shadow flicker occurring.

Cloud amounts are reported as the number of eights (okta) of the sky covered. Irish skies are completely covered by cloud (8 oktas) for over 50% of the time. The mean cloud amount for each hour is between five and six okta. This is due to Ireland's geographical position off the northwest of Europe, close to the path of Atlantic low-pressure systems which tend to keep the country in humid, cloudy airflows for much of the time. A study at 12 stations over a 25-year period showed that the mean cloud amount was at a minimum in April and maximum in July. Cloud amounts were less at night than during the day, with the mean minimum occurring roughly between 2100 and 0100 GMT and the mean maximum occurring between 1000 and 1500 GMT at most stations. (*Source: Met Éireann, www.met.ie*)

2. ***The presence of intervening obstructions between the turbine and the observer:***

For shadow flicker to occur, the windows of a potentially affected property must have direct visibility of a wind turbine, with no physical obstructions such as buildings, trees and hedgerows, hills or other structures located on the intervening land between the window and the turbine.

Any obstacles such as trees or buildings located between a property and the wind turbine will reduce or eliminate the occurrence and/or intensity of the shadow flicker.

3. ***How high the sun is in the sky at a given time:***

At distances of greater than approximately 500m between a turbine and a receptor, shadow flicker generally occurs only at sunrise or sunset when the shadow cast by the turbine is longer. The Guidelines iterates that at distances greater than ten rotor diameters from a turbine, the potential for shadow flicker is very low.

Figure 5-1 illustrates the shadow cast by a turbine at various times during the day; the red shading represents the area where shadow flicker may occur. When the sun is high in the sky, the length of the shadow cast by the turbine is significantly shorter.

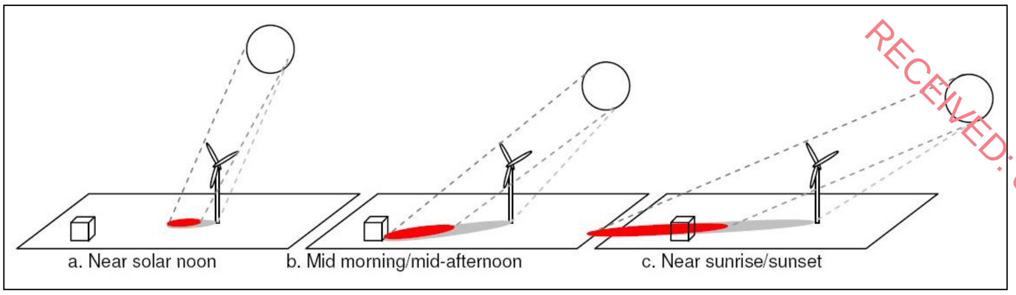

Figure 5-1 Shadow-Prone Area as Function of Time of Day (Source: Shadow Flicker Report, Helimax Energy, Dec 2008)

4. *Distance and bearing, i.e. where the property is located relative to a turbine and the sun:*

The further a property is from the turbine the less pronounced the effect will be. There are several reasons for this: there are fewer times when the sun is low enough to cast a long shadow; when the sun is low it is more likely to be obscured by either cloud on the horizon or intervening buildings and vegetation; and, the centre of the rotor's shadow passes more quickly over the land reducing the duration of the effect.

At a distance, the turbine blades do not cover the sun but only partly mask it, substantially weakening the shadow. This impact occurs first with the shadow from the blade tip, the tips being thinner in section than the rest of the blade. The shadows from the tips extend the furthest and so only a very weak impact is observed at distance from the turbines. (Source: Update of Shadow Flicker Evidence Base, UK Department of Energy and Climate Change, 2010).

5. *Property usage and occupancy:*

Where shadow flicker is predicted to occur at a specific location, this does not imply that it will be witnessed. Potential occupants of a property may be sleeping or occupying a room on another side of the property that is not subject to shadow flicker, or completely absent from the location during the time of shadow flicker events. As shadow flicker usually occurs only when the sun is at a low angle in the sky, i.e. very early in the morning after sunrise or late in the evening before sunset, even if there is a bedroom on the side of the property affected, the shadow flicker may not be witnessed if curtains or blinds in the bedroom are closed. It should be noted, that the below assessment considers a worst-case assessment as detailed in Section 5.9.1 below.

6. *Wind direction, i.e. position of the turbine blades:*

The direction of wind turbine blades changes according to wind direction, as the turbine rotor turns to face the wind. In order to cast a shadow, the turbine blades must be facing directly toward or away from the sun, so they are moving across the source of the light relative to the observer. This is demonstrated in Figure 5-2 below.

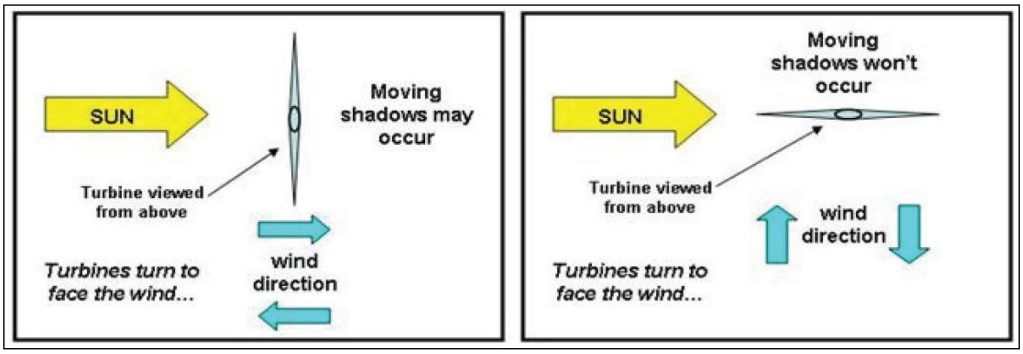

Figure 5-2 Turbine Blade Position and Shadow Flicker Impact (Source: Wind Fact Sheet: Shadow Flicker, Noise Environment Power LLC)

7. ***Rotation of turbine blades:***

Shadow flicker occurs only if there is sufficient wind for the turbine blades to be continually rotating. Wind turbines begin operating at a specific wind speed referred to as the 'cut-in speed', i.e. the speed at which the turbine produces a net power output, and they cease operating at a specific 'cut-out speed'. Therefore, even during the sunlight hours when shadow flicker has been predicted to occur, if the turbine blades are not turning due to insufficient wind speed, then no shadow flicker will occur.

5.2.3.2 Guidance

The current adopted guidance for shadow flicker in Ireland is derived from the Guidelines and the 'Best Practice Guidelines for the Irish Wind Energy Industry' (Irish Wind Energy Association, 2012). The Guidelines state that at distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low. Therefore, the study area adopted for the shadow flicker assessment is 10 rotor diameters of the proposed turbine locations (i.e. for the Proposed Project, this is assumed at 1.63 km based on a rotor diameter of 163 metres).

The Guidelines recommend that shadow flicker at neighbouring offices and dwellings within 500 metres of a proposed turbine location should not exceed a total of 30 hours per year or 30 minutes per day.

The Guidelines state that shadow flicker lasts only for a short period of time and occurs only during certain specific combined circumstances, as follows:

- the sun is shining and is at a low angle in the sky, i.e. just after dawn and before sunset, **and**
- the turbine is located directly between the sun and the affected property, **and**
- there is enough wind energy to ensure that the turbine blades are moving, **and**
- the turbine blades are positioned so as to cast a shadow on the receptor.

Although the Guidelines threshold applies to properties located within 500 metres of a proposed turbine location, for the purposes of this assessment, the thresholds of 30 hours per year or 30 minutes per day have been applied to all properties located within ten rotor diameters of the proposed turbines (as per Best Practice Guidelines for the Irish Wind Energy Industry, IWEA, 2012).

The Guidelines are currently under review. The DoHPLG released the draft Guidelines which were released for public consultation in December 2019. The consultation period closed February 2020; however, no update or final guidelines was released. The draft Guidelines recommend local planning authorities and/or An Bord Pleanála impose conditions to ensure that:

> *"no existing dwelling or other affected property will experience shadow flicker as a result of the wind energy development subject of the planning application and the wind energy development shall be installed and operated in accordance with the shadow flicker study submitted to accompany the planning application, including any mitigation measures required."*

The draft Guidelines are based on the recommendations set out in the 'Proposed Revisions to Wind Energy Development Guidelines 2006 – Targeted Review' (December 2013) and the 'Review of the Wind Energy Development Guidelines 2006 – Preferred Draft Approach' (June 2017).

The Climate Action Plan 2024 published in December 2023 states that final guidelines will be adopted in 2024. The shadow flicker methodology and assessment within this chapter are based on compliance with the Guidelines, which remain to be the current adopted guidelines. However, it should also be noted the proposed turbines can be brought in line with the requirements of the draft Guidelines through the stricter implementation of the mitigation measures outlined in Section 5.10.3.2.7.

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5.2.3.3 Shadow Flicker Prediction Methodology

Shadow flicker occurs only under certain, combined circumstances, as detailed above. Where shadow flicker does occur, it is generally short-lived. The Guidelines state that careful site selection, design and planning, and good use of relevant software can help avoid the possibility of shadow flicker, all of which have been employed in the design of the Proposed Wind Farm. Proper siting of wind turbines is key in eliminating the impact of shadow flicker.

The occurrence of shadow flicker can be precisely predicted using specialist computer software programmes specifically developed for the wind energy industry, such as WindFarm (ReSoft) or WindFarmer (DNV.GL) or AWS OpenWind or WindPRO: Shadow. The computer modelling of the occurrence and magnitude of shadow flicker is made possible by the fact that the sun rises and sets in the same position in the sky on every day each year.

Digital Terrain Modelling (DTM) was used to determine the approximate ground elevation at which the wind turbines and surrounding properties are located for the purpose of running the model. The use of DTM data ensures that realistic elevation variations between the turbines and properties is accounted for.

Any potential impact can be precisely modelled to give the start and end time of any incidence of shadow flicker, at any location, on any day or all days of the year when it might occur. Where a shadow flicker impact is predicted to occur, the total maximum daily and annual durations can be predicted, along with the total number of days. Any incidence of predicted shadow flicker can be attributed to a particular turbine or group of turbines to allow effective mitigation strategies to be planned and proposed as detailed further below.

For the purposes of this shadow flicker assessment, the software package WindPRO: Shadow – Version 4.0.531 has been used to predict the level of shadow flicker associated with the proposed wind farm development. WindPRO is a commercially available software tool that enables developers to analyse, design and optimise proposed wind farms. It allows proposed turbine layouts to be optimised for maximum energy yield whilst taking account of environmental, planning and engineering constraints.

5.2.3.4 Shadow Flicker Assessment Criteria

The proposed wind turbines to be installed on the Proposed Wind Farm site will have a ground-to-blade tip height, hub height and blade length of the following dimensions:

- Turbine Tip Height – 185m
- Hub Height – 103.5m
- Rotor Diameter – 163m

With the benefit of the mitigation measures outlined in Section 5.10.3.2.7, any turbine to be installed onsite will be able to comply with the Guidelines thresholds of 30 minutes per day or 30 hours per year, and if necessary with the draft Guidelines through the use of turbine control software.

5.2.3.5 Shadow Flicker Study Area

At the outset of the Proposed Project, during the constraints mapping process detailed in Chapter 3 of this EIAR, all sensitive receptors within c.2km of the area suitable for siting wind turbines within the EIAR Site Boundary were identified and mapped. This included all occupied and unoccupied dwellings. In addition, a planning history search to identify properties that may have been granted planning permission, but not yet been constructed, was carried out. Any property with a valid planning permission for a dwelling house was also added to the sensitive receptors' dataset.

The Shadow Flicker Study Area for the shadow flicker assessment is ten times rotor diameter (163m rotor diameter x 10 = 1.63km). The Guidelines note that, at distances greater than 10 times the rotor diameter of a proposed turbine, the potential for shadow flicker is very low, and therefore the shadow flicker study area is set at 1.63km from the proposed turbines. All inhabitable dwellings within 1.63km of the proposed turbines have been considered as part of the following shadow flicker assessment. There are 164 no. properties located within 1.63 km of the proposed turbine locations. Of these, a total of 63 no. properties are theoretically predicted to experience shadow flicker.

The Shadow Flicker Study Area is shown in Figure 5-5.

Equine Industry

It is noted that *Section 11.5.3.12* of the Kilkenny County Development Plan 2021-2027 states that:

> *"Applications for wind energy developments shall be accompanied by an assessment detailing potential impacts, mitigation and residual impacts upon the equine industry. Such assessments shall, inter alia, consider issues including noise and shadow flicker."*

Furthermore, Section 11.5.3.6 of the Kilkenny County Development Plan 2021-2027 states that:

> *"For the purposes of this Development Plan, a registered thoroughbred stud farm is considered to be a noise and flicker sensitive property as referred to in the Government's Wind Energy Development Guidelines, and any revisions thereof."*

There are no registered thoroughbred stud farms located within the Shadow Flicker Study Area. The closest registered stud farm is Whytemount Stud, located in Kells, Co. Kilkenny, approximately 14.5km south of the nearest proposed turbine. Therefore, there are no registered thoroughbred stud farms included as sensitive receptors for the purposes of shadow flicker assessment.

5.2.3.5.2 *Assumptions and Limitations*

A precautionary approach has been taken in relation to the orientation of each individual property in relation to the location of the proposed wind turbines through the use of a feature called 'greenhouse mode' within the WindPRO software. This feature assumes shadows can be seen from 360 degrees at a property as opposed to only through windows facing the wind turbines.

No screening due to trees or other buildings or vegetation is assumed. It was not considered necessary or practical to measure the dimensions of every window on every property in the Shadow Flicker Study Area. While the actual size of a window will marginally influence the incidence and duration of any potential shadow flicker impact, with larger windows resulting in slightly longer shadow flicker durations, any additional incidences or durations or shadow flicker over and above those predicted in this assessment can be countered by extending the mitigation strategies outlined in Section 5.10.3.2.7.

Due to the latitude of Ireland shadow flicker impacts are only possible at properties 130 degrees either side of north (i.e., a shadow flicker event can occur within a 260-degree span), as turbines do not cast shadows on their southern side[1]. As such properties located outside of this potential shadow flicker zone (50 degrees either side of south) will not be impacted. However, in taking a precautionary approach for this assessment, all 177 no. properties within 360 degrees of the proposed turbine locations out to 1.63km were assessed for shadow flicker impact.

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[1] *House of Commons ODPM Annual Report and Accounts 2004: Housing, Planning, Local Government and the Regions Committee; Planning Policy Statement 22*
Department of Housing, Planning and Local Government Dec 2019 Draft Revised Wind Energy Development Guidelines. Rialtas Na hÉireann. Available at: https://www.gov.ie/en/publication/9d0f66-draft-revised-wind-energy-development-guidelines-december-2019/

The use of computer models to predict the amount of shadow flicker that will occur is known to produce an over-estimate of possible impact, referred to as the 'worst-case impact', due to the following limitations:

- The sun is assumed to be shining during all daylight hours such that a noticeable shadow is cast. This will not occur in reality.
- The wind is always assumed to be within the operating range of the turbines such that the turbine rotor is turning at all times, thus enabling a periodic shadow flicker. Wind turbines only begin operating at a specific 'cut-in speed', and cease operating at a specific 'cut-out speed'. In periods where the wind is blowing at medium to high speeds, the probability of there being clear or partially clear skies where the sun is shining and could cast a shadow, is low.
- The wind turbines are assumed to be available to operate, i.e. turned on at all times. In reality, turbines may be switched off during maintenance or for other technical or environmental reasons.
- The turbine rotor is considered (as a sphere) to present its maximum aspect to observers in all directions. In reality, the wind direction and relative position of the turbine rotor would result in a changing aspect being presented by the turbine. The rotor will actually present as ellipses of varying sizes to observers from different directions. The time taken for the sun to pass across the sky behind a highly elliptical rotor aspect will be shorter than the modelled maximum aspect.

The total annual shadow flicker calculated for the property assumes 100% sunshine during daytime hours, as referred to above. However, weather data for this region shows that the sun shines on average for 29.44% of the daylight hours per year. This percentage is based on Met Éireann data recorded at Kilkenny over the 30-year period from 1981 to 2010 (www.met.ie). The actual sunshine hours at the Site and therefore the percentage of time shadow flicker could actually occur is 29.44% of daylight hours. Where the annual shadow flicker is calculated for each property, it is corrected for the regional average of 29.44% sunshine, to give an accurate annual average shadow flicker prediction. Table 5-13 below outlines whether a shadow flicker mitigation strategy is required for any property within the Shadow Flicker Study Area which may be impacted by shadow flicker.

5.3 Population

5.3.1 Receiving Environment

The socio-economic study of the receiving environment included an examination of the population and employment characteristics of the area. The relevant methodology pertaining to the population and human health assessment relates to the assessment of desk-based data sourced from the following locations. Information regarding population and general socio-economic data were sourced from the Central Statistics Office (CSO), the Kilkenny County Development Plan 2021-2027, Fáilte Ireland and any other literature pertinent to the area. The study included an examination of the population and employment characteristics of the area. This information was sourced from the Census of Ireland 2022, which is the most recent census for which a complete dataset is available, also the Census of Ireland 2016, the Census of Agriculture 2010 and from the CSO website (www.cso.ie). Census information is divided into State, Provincial, County, Major Town, Electoral Division (ED) level.

The Site is located within a rural setting in northwest Kilkenny, approximately 8.5km west of Kilkenny City. The settlement of Kilmanagh is located directly south of the Site, and the settlement of Tullaroan is located approximately 2.7km north of the nearest proposed turbine. Please refer to Figure 1-1 of Chapter 1 for the Site Location map. The R695 regional road runs in an east-west orientation entering the settlement of Kilmanagh and then heading south from Kilmanagh towards Callan, passing within 1.3km of the nearest proposed turbine. The Site measures approximately 1000 hectares. The Proposed Wind Farm falls within the townlands listed in Table 1-1 of Chapter 1. The Proposed Wind Farm site landuse predominantly comprises a mix of pastoral agriculture and private forestry. The surrounding land uses predominantly comprise pastoral agriculture, and commercial and residential use along local and regional roads and within Kilmanagh and Tullaroan. Existing access to the Site is via farm entrances off the L5023 local road to the west, L5024 local road to the north, and L1009 local road to the south. The Proposed Wind Farm site is also traversed by a number of additional existing agricultural roads and tracks.

In order to assess the population in the vicinity of the Proposed Wind Farm site, the 'Population Study Area' for the population section of this EIAR was defined in terms of Electoral Divisions (EDs). The Proposed Wind Farm site lies within three (3) No. EDs: Ballycallan, Kilmanagh and Tullaroan, as shown in Figure 5-3. These EDs will collectively be referred to hereafter as the Population Study Area for this chapter. The Population Study Area has a population of 1,343 persons as of 2022, with the populations of each electoral division as follows:

- Ballycallan (461 persons)
- Kilmanagh (560 persons)
- Tullaroan (322 person)

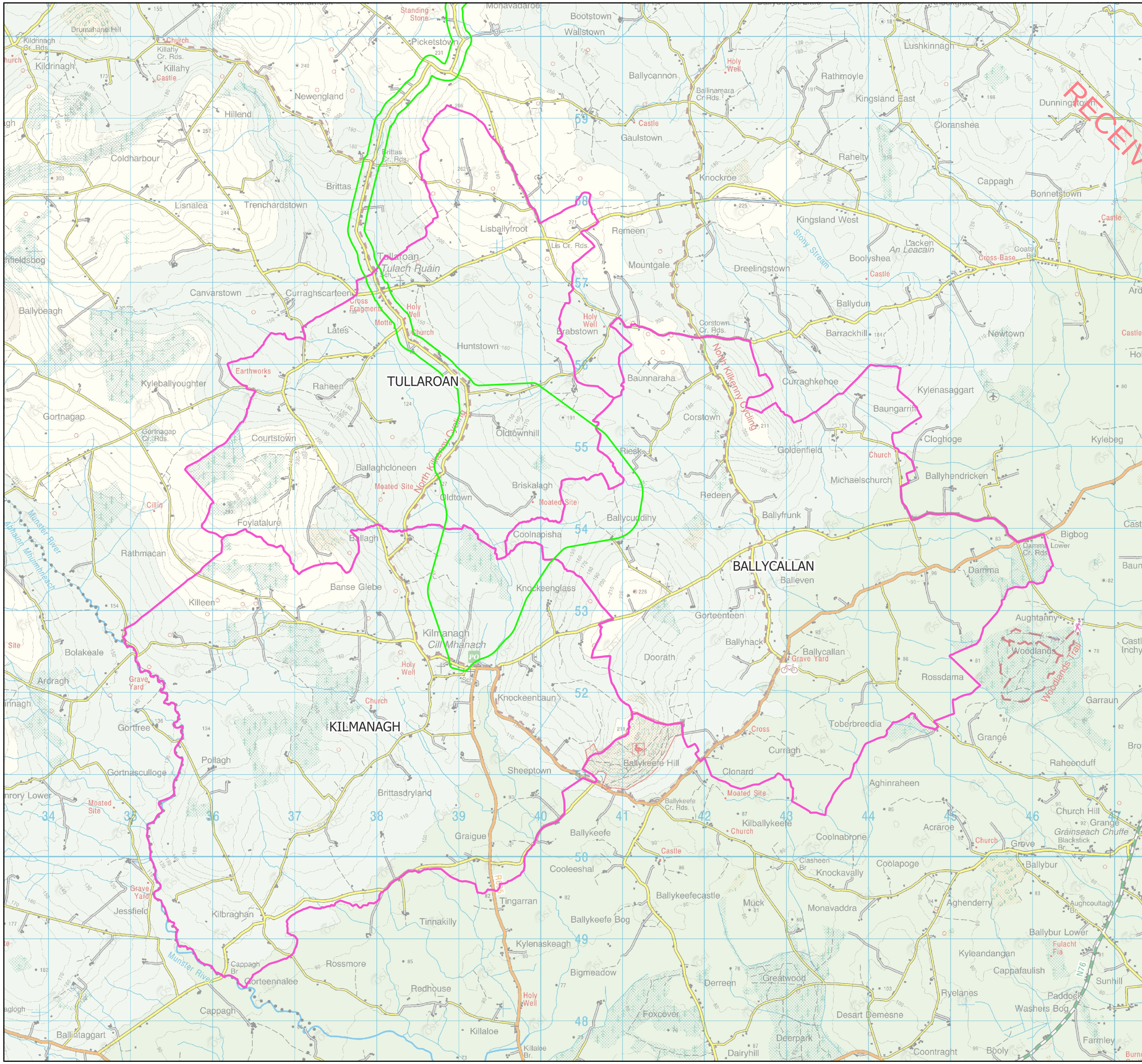
The total land area of the Population Study Area totals 59.72km^2 and comprises Ballycallan 21.05km^2, Kilmanagh 22.89km^2, and Tullaroan 15.78km^2.

There are 45 no. sensitive receptors located within 1 km of the proposed turbine locations. The closest sensitive receptor, belonging to an involved landowner, is located over 500m from the nearest proposed turbine (T4), i.e. over the minimum recommended setback for properties involved in the project (500m). The closest third-party sensitive receptor is located greater than 750m from the nearest proposed turbine (T3), i.e. over the recommended 4x tip height setback (740m) from properties not involved in the project (as recommended in the draft Guidelines).

In order to assess the population in the vicinity of the Proposed Grid Connection, a review of properties and planning applications in the vicinity of the underground electrical cabling route was carried out. There are 256 no. properties located within 100m of the Proposed Grid Connection underground cable route.

The active construction area for the Proposed Grid Connection underground cable route will be small, ranging from 100 to 150 metres in length at any one time, and it will be transient in nature as it moves along the route. Should separate crews be used during the construction phase they will generally be separated by one to two kilometres.

For the purposes of the population baseline assessment, the Proposed Wind Farm will be examined primarily from a population perspective due to the reasons outlined above. Where the Proposed Wind Farm and the Proposed Grid Connection are required to be considered separately, this is identified within the baseline assessment.



Map Legend

- Population Study Areas (3 no. Electoral Divisions)
- EIAR Site Boundary Symbology

Drawing Title

Population Study Area

Project Title

Briskalagh Renewable Energy Development

Drawn By	Checked By
MC	EMC
Project No.	**Drawing No.**
230502	Figure 5-3
Scale	**Date**
1:45,000	2024-08-30

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5.3.2 Population Trends

The recently published Census of 2022 shows that the population of Kilkenny grew by 5% to 104,160 since the 2016 Census. Moreover, the number of people in the county rose by 4,928 between April 2016 and April 2022. Over the same period, Ireland's population grew by 8% from 4,761,865 to 5,149,139. Population statistics for the State, County Kilkenny and the Population Study Area have been obtained from the Central Statistics Office (CSO) and are presented in Table 1 below.

Table 1 Population 2016 – 2022 (Source: CSO)

Area	Population Change		Percentage Population Change
	2016	2022	2016– 2022
State	4,761,865	5,149,139	+8.13%
County Kilkenny	99,232	104,160	+4.97%
Population Study Area	1,246	1,343	+7.78%

The data presented in Table 1 shows that the population of the Population Study Area increased by 7.78% between 2016 and 2022. This rate of population growth is the slightly lower than that recorded at State level and higher than to the County level. When the population data is examined in closer detail, it shows that the rate of population increase within the Population Study Area has been unevenly spread through the Electoral Divisions (EDs). The highest increase in the population between 2016 and 2022 occurred within the Kilmanagh and Tullaroan EDs, which experienced, and 10.24% and 8.05% population increase, respectively. In comparison, the populations of Ballycallan ED, which increased by 4.77% during the same time period. Of the EDs that make up the Population Study Area for this assessment, the highest population was recorded in Kilmanagh ED, with 560 persons recorded during the 2022 Census. The lowest population was recorded in Tullaroan ED, with 322 persons recorded during the 2022 Census.

5.3.3 Population Density

The population densities recorded within the State, County Kilkenny and the Population Study Area during the 2016 and 2022 Censuses are shown in Table 5-2.

Table 2 Population Density in 2016-2022 (Source: CSO)

Area	Population Density (Persons per square kilometre)	
	2016	2022
State	68.06	71.47
County Kilkenny	47.87	50.25
Population Study Area	20.86	22.49

The population density of the Population Study Area recorded during the 2022 Census is 22.49 persons per km^2 which is considerably lower than the national population densities of 71.47 persons per km^2 and lower than the population density of County Kilkenny, recorded at 50.25 persons per km,^{2} respectively. Similar to the observed population trends, the population density recorded across the Population Study Area varies between EDs. Kilmanagh ED has the highest population density, at 24.46

persons per km^2. Ballycallan ED has a lower population density of 21.9 persons per km^2. Tullaroan ED recorded the lowest population density with a total of 20.41 persons recorded per km^2.

5.3.4 Household Statistics

The number of households and average household size recorded within the State, County Kilkenny and the Population Study Area during the 2016 and 2022 Censuses are shown in Table 3.

Table 3 Number of Household and Average Household Size 2016 – 2022 (Source: CSO)

Area	2016		2022	
	No. of Households	Avg. Size (persons)	No. of Households	Avg. Size (persons)
State	1,697,665	2.8	1,841,152	2.74
County Kilkenny	34,855	2.8	36,787	2.8
Population Study Area	1286	3.1	1350	3.1

The figures in Table 3 show that while the number of households within the State, County and the EDs increased, the average number of people per household remained the same due to the proportionate increase in population during this period. Average household size recorded within the Population Study Area during the 2016 and 2022 Censuses is slightly above those observed at State and County level during the same time period. The average household size recorded in the Population Study Area is consistent between EDs. Kilmanagh ED recorded 3.01 persons per household recorded in 2022. Ballycallan recorded the highest with 3.13 persons per household in 2022. Tullaroan ED recorded the lowest with 3 persons per household recorded in 2022 respectively.

5.3.5 Age Structure

Table 4 presents the population percentages of the State, County Kilkenny and Population Study Area within different age groups as defined by the Central Statistics Office during the 2022 Census. This data is also displayed in Figure 5-3.

Table 4 Population per Age Category in 2022 (Source: CSO)

Area	Age Category				
	0 - 14	15 – 24	25 - 44	45 - 64	65 +
State	19.66%	12.52%	27.62%	25.12%	15.08%
County Kilkenny	20.25%	11.72%	25.03%	26.63%	16.38%
Population Study Area	21.21%	11.38%	24.46%	26.93%	16.22%

County Kilkenny's population in April 2022 was comprised of 104,160. The average age of Kilkenny's population in April 2022 was 39.7 years, compared with 37.9 years in April 2016. Nationally, the average age of the population was 38.8, up from 37.4 in April 2016. The number of people aged 65 and over continues to grow. This age group increased by 21.37% to 17,056 in Kilkenny, and by 22% to 776,315 at a national level since 2016. The proportion of the Population Study Area population within each age category is similar to those recorded at national and county level for most categories. For the Study Area, the highest population percentage occurs within the 45-64 age category.

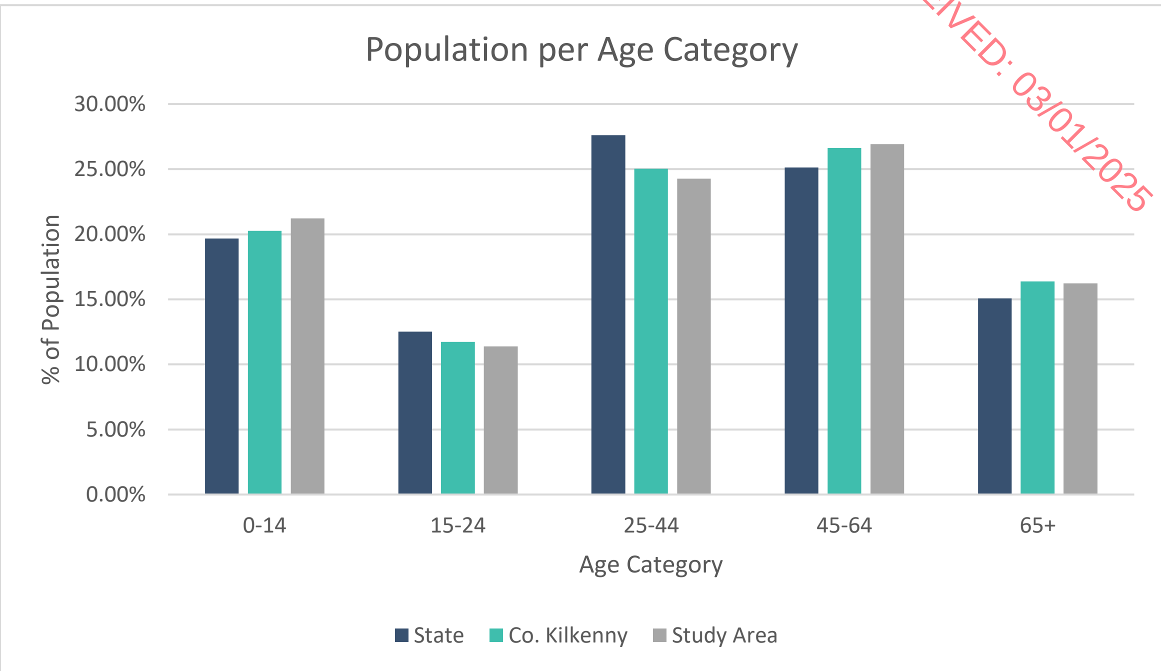

Figure 5-4 Population per Age Category in 2022 (Source: CSO)

5.3.6 Employment and Economic Activity

5.3.6.1 Economic Status of the Population Study Area

The labour force consists of those who can work, i.e., those who are aged 15+, out of full-time education and not performing duties that prevent them from working. There were 46,196 people (aged 15 and over) at work in Kilkenny, an increase of 4,833 people (+11.68%) between 2016 and 2022. Nationally, there were 313,656 additional people (+16%) at work. This figure is further broken down into the percentages that were at work, seeking first time employment or unemployed. It also shows the percentage of the total population aged 15+ who were *not* in the labour force, i.e., those who were students, retired, unable to work or performing home duties.

Table 5 Economic Status of the Total Population Aged 15+ in 2022 (Source: CSO)

Status		State	County Kilkenny	Population Study Area
% of population aged 15+ who are in the labour force		61.18%	60.4%	62.19%
% of which are:	At work	91.67	92.02	95.44
	Looking	1.36	1.25	0.3
	Unemployed	6.96	6.73	4.26
% of population aged 15+ who are not in the labour force		38.82%	39.56%	37.81%
	Student	28.60	25.94	30

Status		State	County Kilkenny	Population Study Area
% of which are:	Home duties	16.96	17.20	17.5
	Retired	40.96	42.67	41.75
	Unable to work	11.79	12.38	9
	Other	1.69	1.81	1.75

Overall, the principal economic status of those within the labour force living in Population Study Area is higher than that recorded at State and County level. Of those who were not in the labour force during the 2022 Census, the highest percentage of the population in the Population Study Area was in the 'Retired' category, which is the same as figures recorded at State and County level that show 'retired' as the highest category.

5.3.6.2 Employment and Investment Potential in the Irish Wind Energy Industry

5.3.6.2.1 *Background*

A report entitled '*Jobs and Investment in Irish Wind Energy – Powering Ireland's Economy*' was published in 2009 by Deloitte, in conjunction with the Irish Wind Energy Association (IWEA). This report focused on the ability of the Irish wind energy industry to create investment and jobs. In terms of the overall economic benefit to be obtained from wind energy, the report states in its introduction:

> *"Ireland is fortunate to enjoy one of the best wind resources in the world. Developing this resource will reduce and stabilise energy prices in Ireland and boost our long-term competitiveness as an economy. It will also significantly reduce our dependence on imported fossil fuels."*

More recently, a report published in 2014 by Siemens entitled '*An Enterprising Wind - An economic analysis of the job creation potential of the wind sector in Ireland*', also in conjunction with the Irish Wind Energy Association (IWEA), concluded that, *'a major programme of investment in wind could have a sizeable positive effect on the labour market, resulting in substantial growth in employment.'* The report considers the three potential types of direct employment created, as a result of increased investment in wind energy, to be:

- Wind Energy Industry Employment:
- Installation
- Development
- Planning
- Operation and Maintenance
- Investor activity
- Electricity Grid Network Employment
- Potential Wind Turbine Manufacturing Employment

The Sustainable Energy Authority of Ireland[2] demonstrates in their '*Wind Energy Roadmap 2011-2050*', that '*the wind energy resource represents a significant value to Ireland by 2050. This value is presented in terms of its ability to contribute to our indigenous energy needs, the benefits of enhanced*

[2] *SEAI (2019), https://www.seai.ie/publications/Wind_Energy_Roadmap_2011-2050.pdf*

employment creation and investment potential, and the ability to significantly abate carbon emissions to 2050.'

5.3.6.2.2 Employment Potential

The 2014 report *"An Enterprising Wind: An economic analysis of the job creation potential of the wind sector in Ireland"* published by the Irish Wind Energy Association (IWEA) predicted that the wind energy sector in Ireland would result in 6,659 direct jobs in a scenario where 4GW capacity is achieved by 2020. This figure of 6,659 is broken down further; 5,596 of these jobs are associated directly with the construction and installation of windfarms, while the remaining 1,063 jobs are associated with the national grid. Under this scenario this contributes 1.66 direct jobs per Megawatt (MW) of wind capacity throughout the various stages of installation. According to Wind Energy Ireland, the installed wind capacity in Ireland is over 4.3GW as of February 2021, which would support employment during the last decade. Ireland needs to achieve a total of 9GW of onshore wind by 2030 which will further support further employment.

The Sustainable Energy Authority of Ireland[3] estimates, in their '*Wind Energy Roadmap 2011-2050*', note that '*Onshore and offshore wind could create 20,000 direct installation and O&M jobs by 2040'.* Furthermore, '*wind energy resource represents a significant value to Ireland by 2050. This value is presented in terms of its ability to contribute to our indigenous energy needs, the benefits of enhanced employment creation and investment potential, and the ability to significantly abate carbon emissions to 2050'.*

The 2014 report '*The Value of Wind Energy to Ireland*', published by Pőyry, stated that growth of the wind sector in Ireland could support 23,850 jobs (construction and operational phases) by 2030. The report states that if Ireland instead chooses to not develop any more wind, then by 2030 the country will be reliant on natural gas for most of our electricity generation, at a cost of €671 million per annum in fuel import costs.

Internationally, a report issued by WindEurope in September 2017, entitled '*Wind energy in Europe: Scenarios for 2030'* details various scenarios in Europe in respect to the EU target for renewable energy. According to WindEurope's High Scenario, which assumes favourable market and policy conditions including the achievement of a 35% EU renewable energy target (slightly higher than the 32% EU target for renewables), '*397 GW of wind energy capacity would be installed in the EU by 2030, 298.5 GW onshore and 99 GW offshore. In this scenario, the wind energy industry would invest €351bn by 2030, and it would create 716,000 jobs'.*

A new report published by MaREI, the SFI Research Centre for Energy, Climate and Marine, hosted by University College Cork[4] (March 2021) details that in order to meet the government target of net-zero carbon emissions by 2050, at least 25,000 jobs will be created in the development of onshore and offshore wind to meet our zero carbon targets.

A more recent report which was issued by WindEurope in February 2022, titled '*Wind Energy in Europe: 2021 Statistics and the Outlook for 2022-2026'* details various scenarios in Europe in respect to the EU target for renewable energy. According to WindEurope's report, '*Europe installed 17GW (11 GW in the EU-27) of new wind capacity in 2021. This is not even half of what the EU should be building to be on track to deliver its 2030 Climate Energy Goals*.' The report continued on to state that '*We expect Europe to install 116 GW of new wind farms over the period from 2022-2026. Three quarters of these new capacity additions will be onshore wind.*' The report also states that '*The European Commission modelling shows that we need at least 79 GW offshore wind but National Government have pledged to build at least 92 GW offshore wind capacity by 2030.'*

[3] SEAI (2019), https://www.seai.ie/publications/Wind_Energy_Roadmap_2011-2050.pdf
[4] https://www.marei.ie/our-climate-neutral-future-zeroby50/

As of April 2024, there were 6,095 Megawatts (MW) of wind energy capacity installed on the island of Ireland[5]. Of this, 4,730 MW was installed in the Republic of Ireland. The majority of the Republic of Ireland's installed wind energy capacity is located in Counties Donegal, Galway, Cork, Clare and Kerry, contributing to employment potential on the Island of Ireland.

5.3.6.2.3 Economic Value

A 2019 report by Baringa, '*Wind for a Euro: Cost-benefit analysis of wind energy in Ireland 2000-2020*', has analysed the financial impact for end consumers of the deployment of wind generation in Ireland over the period 2000-2020. The report calculates how the costs and benefits for consumers would have differed if no wind farms had been built. The analysis indicated that the deployment of 4.1 GW of wind generation capacity in Ireland between 2000 and 2020 (2018-2020 results being projective) will result in a total net cost to consumers, over 20 years, of €0.1bn (€63 million to be exact), which equates to a cost of less than €1 per person per year since 2000. Further cost benefit analysis noted that wind energy has delivered €2.3 billion in savings in the wholesale electricity market. As such, the economic benefit of renewable energy to consumers is greater than what would have been if Ireland did not invest in wind power. This corresponds with the Deloitte report which indicates that more wind energy feeding into the national grid will result in lower and more stable energy costs for consumers.

Furthermore, in May 2020, IWEA released its 70by30 Implementation Plan Reports which further details the savings that can be made from the continuation of onshore wind. The report, entitled '*Saving Money - 70 by 30 Implementation Plan'*, notes that '*Baringa calculated previously that if onshore wind in Ireland can be delivered at €60/MWh, on average, between 2020 and 2030, then the 70 per cent renewable electricity target set out in the Climate Action Plan will actually be cost neutral for the consumer. If we can achieve prices under €60/MWh then Ireland's electricity consumers will be saving money'*.

The Proposed Project will, if consent is granted, contribute to the economic value that renewable energy brings to the country.

5.3.7 Land-Use Patterns and Activities

The land uses within the Site is predominantly comprised of agricultural areas and pastures, as well as small scale commercial forestry. The primary surrounding land use within the Population Study Area is that of agricultural and residential/commercial. The total area of farmland within the three EDs, around the Site, measures approximately 5,398.4 hectares, comprising 90% of the Population Study Area, according to the CSO Census of Agriculture 2020. There are 99 farms located within the three EDs, with an average farm size of 54.53 hectares. This is higher than the average 45.7-hectare farm size for Co. Kilkenny. Table 6 shows the breakdown of farmed lands within the three EDs. Pasture accounts for the largest proportion of farmland, followed by Rough Grazing.

Table 6 Farm Size and Classification within the Population Study Area in 2020 (Source: CSO)

DED	No of holdings	Average size (hectares)	Median age of holder	Livestock units	Average farmed (hectares)
Tullaron	28	50.6	52	2,801	1418.1
Kilmanagh	34	49	55	2,886	1646

[5] *Eirgrid, https://www.eirgrid.ie/grid/system-and-renewable-data-reports*

Ballycallan	37	63.1	54	3,756	2334.3
Total	220	41.7 (average)	57 (average)	18,077	3,050.23 (average)
Size of 3 EDs			5,972 hectares		
Total Area Farmed within 3 EDs			5,398.4 hectares		
Farmland as % of EDs			90%		

5.3.8 Services

The settlement of Kilmanagh is located directly south of the Proposed Wind Farm site, and the settlement of Tullaroan is located approximately 2.7km north of the nearest proposed turbine. Other settlement areas in the wider region include Callan (approximately 8.5km to the south of the Proposed Wind Farm site), Urlingford (approximately 14km northwest of the Proposed Wind Farm site), Ballyragget (approximately 16.4km northeast of the Proposed Wind Farm site), and Kilkenny City (approximately 8.5km east of the Proposed Wind Farm site). All centres provide retail, recreational, educational, and religious services.

5.3.8.1 Education

The nearest primary school is St. Aidan's National School in Kilmanagh directly south of the Site. Beyond that is Scoil Ruadhain Tullaroan approx. 2.9km northwest of the nearest proposed turbine. The nearest secondary school is located in Kilkenny – Loreto Secondary School and is 9km to the east. The Mary Immaculate College (Thurles campus), is located approximately 26km west of the Site.

5.3.8.2 Access and Public Transport

The Proposed Wind Farm site is currently accessible via farm entrances off the L5023 local road to the west, L5024 local road to the north, and L1009 local road to the south. The Site is also served by a number of additional existing agricultural roads and tracks. There is no public transport access to the Proposed Wind Farm. The nearest public transport access (public bus stop) is in Callan, located approximately 8.5km from the Site.

5.3.8.3 Amenities and Community Facilities

There are no amenity or community facilities located within or adjacent to the Site, however there are several in the surrounding area. Located directly south of the Site near Kilmanagh is the Graigue Ballycallan GAA. The River Rangers AFC is also located 3.3km southeast of the nearest proposed turbine. Amenities and community facilities, including other sports clubs, youth clubs, and recreational areas are located in Callan, Freshford, Ballyragget and Kilkenny City.

Community Benefit proposals, which would provide the opportunity to enhance local amenities and community facilities are described in Chapter 4: Description of the Proposed Project.

5.4 Tourism

For the purposes of this section, the Proposed Wind Farm is considered solely in relation to the tourism baseline assessment set out below in Section 5.4.1 – 5.4.3. Due to the temporary nature of the works and any potential effects associated with the Proposed Grid Connection underground cabling route, it has been scoped out from the tourism assessment that follows.

5.4.1 Tourism and Revenue

Tourism is one of the major contributors to the national economy and is a significant source of full time and seasonal employment. *Key Tourism Facts 2019*, pertaining to domestic and international tourism volumes for Ireland, was published by Failte Ireland in 2021 for the year 2019. *Key Tourism Facts 2019* states that during 2019, overseas tourists to Ireland grew by 0.7% to 9.7 million. In 2019, out-of-state (Overseas and Northern Ireland) tourist expenditure amounted to €5.6 billion. With a further €1.8 billion spent by overseas visitors on fares to Irish carriers, foreign exchange earnings were €7.4 billion. Domestic tourism expenditure amounted to €2.1 billion, making tourism a €9.5 billion industry. The Central Statistics Office's official count of direct employment in 'Accommodation and food service activities', a category which includes hotels, restaurants, bars, canteens and catering, was 177,700 in Q3 2019 (7.6% of total employment) and rises to 260,000 when including seasonal and casual employment in the industry.

Key Tourism Facts 2022, published in October 2023 does not provide the same level of detail in terms of tourist numbers and expenditure as the 2019 version of the same report, however it does note that

> *"While traditional tourism statistics focus primarily on 'flows' (i.e., the number of visitors, the number of overnight stays, etc.), Gross Value Added (GVA) measures the overall contribution of a particular sector to national income. Tourism activity in Ireland is associated with over 4% of direct GVA."*

Key Tourism Facts 2022 goes on to state that through an alternative method of estimating employment using PAYE tax data, the CSO estimates the number of people employed in 'Tourism Industries' to be 220,000 in Q3 2022.

The Republic of Ireland is divided into seven tourism regions. Table 7 shows the total revenue and breakdown of overseas tourist numbers to each region in Ireland during 2019 ('*Key Tourism Facts 2019*, Fáilte Ireland, March 2021).

Table 7 Overseas Tourists Revenue and Numbers 2019 (source Fáilte Ireland)

Region	Total Revenue (€m)	Total Number of Non-Domestic Tourists (000s)
Dublin	€2,210m	6,644
Mid-East/Midlands	€348m	954
South-East	**€261m**	**945**
South-West	€970m	2,335
Mid-West	€472m	1,432
West	€653m	1,943
Border	€259m	768
Total	**€5,173 m**	**15,021**

The South-East Region, in which the Site is located, comprises Counties Kilkenny, Carlow, Waterford and Wexford. This Region benefited from approximately 6% of the total number of overseas tourists to the country and approximately 5% of the total tourism income generated in Ireland in 2019.[6]

Table 5-8 presents the county-by-county breakdown of overseas tourist numbers and revenue to the South-East Region during 2017 (‘*2017 Topline Tourism Performance By Region, Fáilte Ireland, August 2018*)[7]. There is no published County by County tourism breakdown for 2018 to 2024 to date). As can be observed Kilkenny had a tourism revenue of at €94 million.

Table 8 Overseas Tourism to Border Region during 2017 (Source: Fáilte Ireland)

County	Revenue Generated by Overseas and Domestic Tourists (€m)	No. of Overseas Tourists (000s)
Kilkenny	94	315
Carlow	81	79
Tipperary (South)	88	139
Waterford	127	255
Wexford	207	232

5.4.2 Tourist Attractions

There are no key identified tourist attractions pertaining specifically to the Site.

5.4.2.1.1 *Tourism Attractions within the surrounding landscape*

The nearest identified tourist attraction is the Ballykeefe Amphitheatre, located within the old Ballykeefe Quarry, is an outdoor amphitheatre with crowd capacity of 850 people. It is located c. 2.6km to the south of the Site.

County Kilkenny has a wide range of nationally and regionally significant tourism assets which include the following:

- Kilkenny Castle - a Victorian remodelling of the thirteenth century defensive Castle located within Kilkenny City c. 10km east of the boundary of Site.
- St Canice’s Cathedral & Round Tower – an ecclesiastical site founded in the 6th century, located c. 9km east of the Site.
- Jerpoint Abbey – constructed in 1180 and located c. 21km southeast of the Site.

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6 Failte Ireland Key Tourism Facts 2019, March 2021. Available at: https://www.failteireland.ie/FailteIreland/media/WebSiteStructure/Documents/3_Research_Insights/4_Visitor_Insights/KeyTourismFacts_2019.pdf?ext=.pdf

7 2017 Topline Tourism Performance By Region, Fáilte Ireland, August 2018. Available at: https://www.failteireland.ie/FailteIreland/media/WebSiteStructure/Documents/3_Research_Insights/2_Regional_SurveysReports/2017-topline-regional-tourism-performance.pdf?ext=.pdf

- Kells Priory – one of the largest medieval monuments in Ireland which includes a collection of medieval tower houses spaced at intervals along and within walls which enclose a site of just over 3 acres, located c. 14km southeast of the Site.
- A number of gardens including Kilfane Glen in Thomastown, Woodstock Garden in Inistioge, the Discovery Park in Castlecomer.

Archaeological sites and monuments are part of Irish national heritage and are recognised tourist attractions across the country. National Monuments within 10km of the nearest turbine are listed below. It should be known that not all of these National Monuments are publicly accessible. Please see Chapter 13 Archaeology and Cultural Heritage for further details.

- Tullaroan Church – comprises a church located c. 2.1km from the nearest proposed turbine, T3.
- Ringfort, Rathealy – a ringfort in Rathealy townland, however, the monument description refers to it as a Castle – ringwork. It is located c. 5.8km to the north of the nearest proposed turbine, T1.
- Ballylarkin Church – the ruined church at Ballylarkin Upper is located c. 8.7km to the north of the nearest proposed turbine, T1.
- Callan Motte, Westcourt Demesne – a motte located in the townland of Westcourt Demesne, Callan. It is situated c. 9.7km to the south-south-east of the nearest proposed turbine, T7.
- Augustinian Friary – this Augustinian friary is also located in Callan, c. 9.9km south-south-east of the nearest proposed turbine, T7.
- Town defences, Callan – there are no upstanding remains of the town defences at Callan, however, they are still regarded as a National Monument on the basis of the National Policy on Town Defences (2008). The town defences at Callan are located within c. 10km of the nearest proposed turbine, T7.
- Burnchurch castle and tower - located c. 9.8km south-east of the nearest proposed turbine, T4.
- 19th Century House, Farranrory Upper – located in county Tipperary c. 6.9km south-west of the nearest proposed turbine, T7. The house is associated with the 1848 rebellion.
- Town Defences, Kilkenny – the town defences of Kilkenny are also regarded as a National Monument. A number of sections of the defences in Kilkenny are subject to a Preservation Order. The town defences are located c. 9.7km from the nearest proposed turbine, T4.
- Ringfort, Tullaroan – This ringfort subject to a Preservation Order (10/1956) is located in the townland of Tullaroan c. 3.4km north-west of the nearest proposed turbine, T1.

5.4.3 Tourist Attitudes to Wind Farms

5.4.3.1 Scottish Tourism Study 2021

BiGGAR Economics undertook an independent study in 2021, entitled '*Wind Farms & Tourism Trends in Scotland: Evidence from 44 Wind Farms*' to understand the relationship, if any, that exists between the development of onshore wind and the sustainable tourism sector in Scotland. In recent years, the onshore wind sector and sustainable tourism sector have grown significantly in Scotland. However, it could be argued that if there was any relationship between the growth of onshore wind energy and tourism, it would be at a more local level. This study therefore considered the evidence at a local authority level and in the immediate vicinity of constructed wind farms.

Since 2009, the onshore wind sector has expanded considerably in Scotland. Employment in tourism-related sectors in Scotland also grew during the years since 2009, an overall increase of 20%.

Analysis of the rates of change in the number of onshore wind turbines and in tourism-related employment in local authority areas, found that there is no correlation between the two factors. This applies to whether the analysis covers the decade between 2009 – 2019, or the more recent 2015 to 2019 period.

The research also analysed trends in tourism employment within the immediate vicinity of wind farm developments. This included 16 no. wind farms with a capacity of at least 10MW that became operational between 2015 and 2019. Analysis of trends in tourism employment in the locality of these wind farms (study areas were based on a 15km radius) found that 11 of these 16 areas had experienced more growth in tourism employment than for Scotland as a whole. For 12 of the 16 wind farms, trends in tourism employment in the locality had outperformed the local authority area in which they were based.

The research also re-examined 28 wind farms constructed between 2009 and 2015 that had been analysed in a previous study published in 2017, finding that the localities in which they were based had outperformed Scotland and their local authority areas in the majority of cases. Moreover, the analysis, found that in the seven areas which had underperformed their local authority areas in the 2017 study, four had done better than their local authorities in the 2015 to 2019 period.

This research analysed trends in tourism employment in the localities of 44 no. wind farms developed in recent years, providing a substantial evidence base. The study found no relationship between tourism employment and wind farm development, at the level of the Scottish economy, across local authority areas, not in the locality of the wind farm sites.

5.4.3.2 Fáilte Ireland Surveys 2007 and 2012

In 2007, Fáilte Ireland in association with the Northern Ireland Tourist Board carried out a survey of domestic and overseas holidaymakers to Ireland in order to determine their attitudes to wind farms. The purpose of the survey was to assess whether the development of wind farms impacts on the enjoyment of the Irish scenery by holidaymakers. The survey involved face-to-face interviews with 1,300 tourists (25% domestic and 75% overseas). The results of the survey are presented in the Fáilte Ireland Newsletter 2008/No.3 entitled 'Visitor Attitudes on the Environment: Wind Farms'.

The Fáilte Ireland survey results indicate that most visitors are broadly positive towards the idea of building wind farms in Ireland. There exists a sizeable minority (one in seven) however who are negative towards wind farms in any context. In terms of awareness of wind farms, the findings of the survey include the following:

- Almost half of those surveyed had seen at least one wind farm on their holiday to Ireland. Of these, two thirds had seen up to two wind farms during their holiday.
- Typically, wind farms are encountered in the landscape while driving or being driven (74%), while few have experienced a wind farm up close.
- Of the wind farms viewed, most contained less than ten turbines and 15% had less than five turbines.

Regarding the perceived impact of wind farms on sightseeing, the Fáilte Ireland report states:

> *"Despite the fact that almost half of the tourists interviewed had seen at least one wind farm on their holiday, most felt that their presence did not detract from the quality of their sightseeing, with the largest proportion (45%) saying that the presence of the wind farm had a positive impact on their enjoyment of sightseeing, with 15% claiming that they had a negative impact."*

In assessing the perceived impact of wind farms on beauty, visitors were asked to rate the beauty of five different landscapes types: Coastal, Mountain, Farmland, Bogland and Urban Industrial, and then rate on a scale of 1-5 the potential impact of a wind farm being sited in each landscape. The survey found that each potential wind farm must be assessed on its own merits. Overall however, in looking at wind farm developments in different landscape types, the numbers claiming a positive impact on the landscape due to wind farms were greater than those claiming a negative impact, in all cases.

Regarding the perceived impact of wind farms on future visits to the area, the Fáilte Ireland survey states:

> *"Almost three quarters of respondents claim that potentially greater numbers of wind farms would either have no impact on their likelihood to visit or have a strong or fairly strong positive impact on future visits to the island of Ireland. Of those who feel that a potentially greater number of wind farms would positively impact on their likelihood to visit, the key driver is their support for renewable energy and potential decreased carbon emissions."*

The report goes on to state that while there is a generally positive disposition among tourists towards wind development in Ireland, it is important also to take account of the views of the one in seven tourists who are negatively disposed towards wind farms. This requires good planning on the part of the wind farm developer as well as the Local Authority. Good planning has been an integral component of the Proposed Project throughout the design and assessment processes. Reference has been made to the '*Planning Guidelines on Wind Energy Development 2006*' and the '*Draft Revised Wind Energy Development Guidelines December 2019*' in addition to WEI (previously IWEA) best practice guidance, throughout all stages, including pre-planning consultation and scoping.

The 2007 survey findings are further upheld by a more recent report carried out by Fáilte Ireland on tourism attitudes to wind farms in 2012. The results of the updated study were published in the 'Fáilte Ireland Newsletter 2012/No.1 entitled 'Visitor Attitudes on the Environment: Wind Farms – Update on 2007 Research'. The updated survey found that of 1,000 domestic and foreign tourists who holidayed in Ireland during 2012, over half of tourists said that they had seen a wind turbine while travelling around the country. Of this number of tourists, 21% claimed wind turbines had a negative impact on the landscape. However, 32% said that it enhanced the surrounding landscape, while 47% said that it made no difference to the landscape. Almost three quarters of respondents claim that potentially greater numbers of wind farms would either have no impact on their likelihood to visit or have a strong or fairly strong positive impact on future visits to the island of Ireland.

Further details regarding the general public perception of wind energy, including those living in the vicinity of a wind farm, are presented in Section 5.5 below.

5.5 Public Perception of Wind Energy

5.5.1 Sustainable Energy Authority of Ireland Survey 2003

5.5.1.1 Background

The results of a national survey entitled '*Attitudes Towards the Development of Wind Farms in Ireland*' were published by the Sustainable Energy Authority of Ireland (SEAI) in 2003 and updated in 2017. A catchment area survey was also carried out by SEAI (formerly SEI) in order to focus specifically on people living with a wind farm in their locality or in areas where wind farms are planned.

5.5.1.2 2003 Findings

The SEAI survey published in 2003, found that the overall attitude to wind farms is very positive, with 84% of respondents rating it positively or very positively. One percent rates it negatively and 14% had no opinion either way. Approximately two thirds of respondents (67%) were found to be positively disposed to having a wind farm in their locality. Where negative attitudes were voiced towards wind farms, the visual effect of the turbines on the landscape was the strongest influence. The report also notes however that the findings obtained within wind farm catchment areas showed that effect on the landscape is not a major concern for those living near an existing wind farm.

With regards to the economic and environmental effects of wind farm development, the national survey reveals that attitudes towards wind energy are influenced by a perception that wind is an attractive source of energy:

> *"Over 8 in 10 recognise wind as a non-polluting source of energy, while a similar number believe it can make a significant contribution to Ireland's energy requirements."*

The study reveals uncertainty among respondents with regards to the issues of noise levels, local benefits and the reliability or otherwise of wind power as an energy source. It goes on to state however that the finding that people who have seen wind farms rate these economic and environmental factors more favourably is a further indication that some experience of the structures tends to translate into positive attitudes towards wind energy.

Similar to the national survey, the surveys of those living within the vicinity of a wind farm also found that the findings are generally positive towards wind farms. Perceptions of the effect of the development on the locality were generally positive, with some three-quarters of interviewees believing it had impacted positively.

In areas where a wind farm development had been granted planning permission but was not yet under construction, three quarters of the interviewees expressed themselves in favour of the wind farm being built in their area. Four per cent were against the development. The reasons cited by those who expressed themselves in favour of the wind farm included the fact that wind energy is clean (78%), it would provide local jobs (44%), it would help develop the area (32%) and that it would add to the landscape (13%). Those with direct experience of a wind farm in the locality are generally impressed with it as an additional feature in the landscape. The report states:

> *"It is particularly encouraging that those with experience of wind turbines are most favourable to their development and that wind farms are not solely seen as good in theory, but are also seen as beneficial when they are actually built."*

Few of those living in proximity either to an existing wind farm or one for which permission has been granted believe that the development damages the locality, either in terms of damage to tourism potential or to wildlife. The survey found that there is a clear preference for larger turbines in smaller numbers over smaller turbines in larger numbers.

5.5.1.3 Survey Update 2017

Additionally, a survey carried out by Interactions in October 2017, published by the SEAI, show 47% of Irish adults polled said they were strongly in favour of wind power in Ireland while a further 38% favour it. Overall, this is a 4% increase in favourable attitudes towards wind power compared with similar research in 2013.

The SEAI survey found that the overall attitude to wind farms is very positive, with 84% of respondents in favour of the use of wind energy in Ireland. Approximately two thirds of respondents (70%) would prefer to power their home with renewable energy over fossil fuels, and 45% would be in favour of a wind farm development in their area.

The survey also captured the perceived benefits of wind power among the public. Of those surveyed three quarters selected good for the environment and reduced Carbon Dioxide emissions while fewer people, just over two in three, cited cheaper electricity.

5.5.1.4 Conclusions

The main findings of the SEAI survey in 2017 indicate that the overall attitude to wind farms is “almost entirely positive”. The study highlights that two-thirds of Irish adults are either very favourable or fairly favourable to having a wind farm built in their locality, with little evidence of a “Not In My Back Yard” (NIMBY) effect. The final section of the 2017 report states:

> *“The overwhelming indication from this study is that wind energy enjoys great support and, more specifically, that the development of wind farms is supported and welcomed. The single most powerful indicator of this is to be found among those living in proximity to an existing wind farm: over 60% would be in favour of a second wind farm or an extension of the existing one. This represents a strong vote in favour of wind farm developments – especially important since it is voiced by those who know from direct experience about the impact of such developments on their communities.”*

5.5.2 Public Perceptions of Wind Power in Scotland and Ireland Survey 2005

5.5.2.1 Background

A survey of the public perception of wind power in Scotland and Ireland was carried out in 2003/2004 by researchers at the School of Geography & Geosciences, University of St. Andrews, Fife and The Macaulay Institute, Aberdeen (‘*Green on Green: Public Perceptions of Wind Power in Scotland and Ireland*’, Journal of Environmental Planning and Management, November 2005). The aims of the study were to ascertain the extent to which people support or oppose wind power, to investigate the reasons for these attitudes and to establish how public attitudes relate to factors such as personal experience of operational wind farms and their proximity to them.

5.5.2.2 Study Area

Surveys were carried out at two localities in the Scottish Borders region, one surrounding an existing wind farm and one around a site at which a wind farm had received planning permission but had not yet been built. Surveys were also carried out in Ireland, at two sites in Counties Cork and Kerry, each of which had two wind farms in proximity to each other.

5.5.2.3 Findings

The survey of public attitudes at both the Scottish and Irish study sites concluded that large majorities of people are strongly in favour of their local wind farm, their personal experience having engendered positive attitudes. Attitudes towards the concept of wind energy were described as “overwhelmingly positive” at both study sites in Scotland, while the Irish survey results showed almost full support for renewable energy and 92% support for the development of wind energy in Ireland.

The results of the survey were found to agree with the findings of previous research, which show that positive attitudes to wind power increase through time and with proximity to wind farms. With regards to the NIMBY effect, the report states that where NIMBY-ism does occur, it is much more pronounced in relation to proposed wind farms than actual wind farms. The Scottish survey found that while positive attitudes towards wind power were observed among those living in proximity to both the proposed and existing wind farm sites, people around the proposed site were less convinced than those living in proximity to the existing site. Retrospective questioning regarding pre- and post-construction attitudes at the existing site found that attitudes remained unchanged for 65% of respondents. Of the 24% of people who altered their attitudes following experience of the wind farm, all but one became more positive. The report states:

> *"These results support earlier work which has found that opposition to wind farms arises in part from exaggerated perceptions of likely impact, and that the experience of living near a wind farm frequently dispels these fears. Prior to construction, locals typically expect the landscape impacts to be negative, whereas, once in operation, many people regard them as an attractive addition."*

The reasons that people gave for their positive attitude to the local wind farm were predominantly of a global kind, i.e. environmental protection and the promotion of renewable energy, together with opposition to a reliance on fossil fuels and nuclear power. Problems that are often cited as negative effects of wind farms, such as interference with telecommunications and shadow flicker were not mentioned at either site. With regards to those who changed to a more positive attitude following construction of the wind farm, the reasons given were that the wind farm is *"not unattractive (62%), that there was no noise (15%), that community funding had been forthcoming (15%) and that it could be a tourist attraction (8%)".*

The findings of the Irish survey reinforce those obtained at the Scottish sites with regards to the increase in positive attitudes to wind power through time and proximity to wind farms. The survey of public attitudes at the sites in Cork and Kerry found that the highest levels of support for wind power were recorded in the innermost study zone (0 – 5 kilometres from a point in between the pair of wind farms). The data also suggests that *"those who see the wind farms most often are most accepting of the visual impact".* The report also states that a previous Irish survey found that most of those with direct experience of wind farms do not consider that they have had any adverse effect on the scenic beauty of the area, or on wildlife, tourism or property values. Overall, the study data reveals *"a clear pattern of public attitudes becoming significantly more positive following personal experience of operational wind farms".*

With regards to wind farm size, the report notes that it is evident from this and previous research that wind farms with small numbers of large turbines are generally preferred to those with large numbers of smaller turbines.

5.5.2.4 Conclusions

The overall conclusions drawn from the survey findings and from the authors' review of previous studies show that local people become more favourable towards wind farms after construction, that the degree of acceptance increases with proximity to them, and that the NIMBY effect does not adequately explain variations in public attitudes due to the degree of subjectivity involved.

5.5.3 IWEA Interactions Opinion Poll on Wind Energy

Published in January 2020, IWEA undertook a national opinion poll on Wind Energy November 2019 with the objective to "*measure and track public perceptions and attitudes around wind energy amongst Irish adults.*" Between November 20th – 30th 2019, a nationally represented sample of 1,019 adults and a booster sample of 200 rural residents participated in an online survey. The 2019 results indicate that 79% of both the nationally represented sample and rural sample strongly favour or favour wind power while 16% of both samples neither favour or oppose it. Amongst those in favour of wind power, the majority cited environmental and climate concerns as their main reasons for supporting such developments. Other reasons cited for supporting wind energy developments include: "economic benefits," "reliable/efficient," "positive experience with wind energy" and recognise it as a "safe resource." When questioned about wind developments in their local area, 55% of nationally represented sample favour or tend to favour such proposals and 51% of the rural population reported the same. Reasons cited for supporting wind developments in their local area include: "good for the environment," "social responsibility," "create jobs," "good for the community."

The IWEA November 2019 survey follows previous national opinion polls on wind energy undertaken in October 2017 and November 2018. The 2019 survey results are consistent with the 2017 and 2018 figures and thus indicate that approximately 4 out of 5 Irish adults have continued to support for wind energy in recent years.

5.5.4 Wind Energy Ireland Public Attitudes Monitor

Published in December 2022, IWEA undertook a national opinion poll on Wind Energy in Q4 of 2022 with the objective '*to measures & track the perceptions and attitudes around wind energy amongst Irish adults*'. Between November 23rd and December 8th 2022, a nationally represented sample of 1,017 and a booster samples of 201 rural dwellers participated in the survey. The 2022 results indicate that 80% of the nationally representative sample and 85% of the rural sample strongly favour or favour wind power. Almost half (45%) of those surveyed ranked cheaper electricity as the top wind energy benefit. Amongst rural residents, the percentage of people producing negative feedback is reducing year on year. Nationally, 58% of people said that they would be in favour of a wind farm in their area, which is the highest number in favour since tracking began. Amongst rural residents, just 1 in 10 people registered being opposed to having a wind farm in their local area.

The IWEA December 2022 survey follows previous national opinion polls on wind energy undertaken by IWEA in November 2019 and November 2018. The 2022 survey results are consistent with the 2019 and 2018 figures and thus indicate that 4 out of 5 Irish adults have continued to support wind energy in recent years.

5.6 Health Effects of Wind Farms

5.6.1 Introduction

The 2022 Census of Ireland as carried out by the Central Statistics Office provides the general health conditions of the population of the EDs which make up the Population Study Area for the Proposed Project. The vast majority of those within the Population Study Area marked their general health as being 'very good' across all EDs. It is not anticipated that the general health of the population of the Population Study Area be altered due to the Proposed Project.

5.6.2 Health Impact Studies

While there are anecdotal reports of negative health effects on people who live very close to wind turbines, peer-reviewed research has not supported these statements. There is currently no published credible scientific evidence to positively link wind turbines with adverse health effects. The main publications supporting the view that there is no evidence of any direct link between wind turbines and health are summarised below.

1. ***'Wind Turbine Sound and Health Effects – An Expert Panel Review',*** *American Wind Energy Association and Canadian Wind Energy Association, December 2009*

This expert panel undertook extensive review, analysis and discussion of the large body of peer-reviewed literature on sound and health effects in general, and on sound produced by wind turbines in particular. The panel assessed the plausible biological effects of exposure to wind turbine sound. Following review, analysis, and discussion of current knowledge, the panel reached consensus on the following conclusions:

- "There is no evidence that the audible or sub-audible sounds emitted by wind turbines have any direct adverse physiological effects.
- The ground-borne vibrations from wind turbines are too weak to be detected by, or to affect, humans.
- The sounds emitted by wind turbines are not unique. There is no reason to believe, based on the levels and frequencies of the sounds and the panel's experience with

sound exposures in occupational settings, that the sounds from wind turbines could plausibly have direct adverse health consequences."

The report found, amongst other things, that:

- "Wind Turbine Syndrome" symptoms are the same as those seen in the general population due to stresses of daily life. They include headaches, insomnia, anxiety, dizziness, etc.
- Low frequency and very low-frequency 'infrasound' produced by wind turbines are the same as those produced by vehicular traffic and home appliances, even by the beating of people's hearts. Such 'infrasounds' are not special and convey no risk factors;
- The power of suggestion, as conveyed by news media coverage of perceived 'wind-turbine sickness', might have triggered 'anticipatory fear' in those close to turbine installations."

2. ***'Wind Turbine Syndrome – An independent review of the state of knowledge about the alleged health condition',*** *Expert Panel on behalf of Renewable UK, July 2010*

This report consists of three reviews carried out by independent experts to update and understand the available knowledge of the science relating to infrasound generated by wind turbines. This report was prepared following the publication of a book entitled '*Wind Turbine Syndrome*', in 2009 by Dr. Pierpont, which received significant media attention at the time. The report discusses the methodology and assessment carried out in the 2009 publication and assessed the impact of low-frequency noise from wind turbines on humans. The independent review found that:

- "The scientific and epidemiological methodology and conclusions drawn (in the 2009 book) are fundamentally flawed;
- The scientific and audiological assumptions presented by Dr Pierpont relating infrasound to WTD are wrong; and
- Noise from Wind Turbines cannot contribute to the symptoms reported by Dr. Pierpont's respondents by the mechanisms proposed."

Accordingly, the consistent and scientifically robust conclusion remains that there is no evidence to demonstrate any significant health effects in humans arising from noise at the levels of that generated by wind turbines.

3. ***'The Health Effects of 72 Hours of Simulated Wind Turbine Infrasound: A Double-Blind Randomized Crossover Study in Noise-Sensitive Health Adults'*** *Woolcock Institute for Medical Research, New South Wales Australia*

The purpose of this study was to examine the potential health effects of audible sound and inaudible infrasound has on noise sensitive adults over a period of 72 hours. Sufferers of wind turbine syndrome (WTS) have attributed their ill-health and particularly their sleep disturbance to the signature of infrasound. On this basis, the objectives of the study were to test the effects of 72 hours of infrasound exposure on human physiology, particularly sleep. The results of the study are outlined below:

- All staff and participants were asked whether they were able to differentiate in any way between infrasound and sham infrasound (the control), and none of them were able to.
- The study found that 72 hours of the simulated wind turbine infrasound (~90dB pk re 20 µPa) in controlled laboratory conditions did not worsen any measure of sleep quality compared with the same speakers being present but not generating infrasound (sham infrasound).

- The study found no evidence of that 72 hours of exposure to a sound level of ~90dB pk re 20 µPa of simulated wind turbine infrasound in double-blind conditions perturbed any physiological or psychological variable.
- None of the participants in the study who were exposed to infrasound developed what could be described as Wind Turbine Syndrome.
- This study suggests that the infrasound component of Wind Turbine Syndrome is unlikely to be a cause of any ill-health or sleep disruption, although this observation should be independently replicated.

4. ***'A Rapid Review of the Evidence',*** *Australian Government National Health and Medical Research Council (NHMRC) Wind Turbines & Health, July 2010*

The purpose of this paper was to review evidence from current literature on the issue of wind turbines and potential effects on human health and to validate the finding of the 'Wind Turbine Sound and Health Effects - An Expert Panel Review' (see Item 2 above) that:

- "There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines."
- There is currently no published scientific evidence to positively link wind turbines with adverse health effects.
- 'This review of the available evidence, including journal articles, surveys, literature reviews and government reports, supports the statement that: There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines."

5. ***'Position Statement on Health and Wind Turbines',*** *Climate and Health Alliance, February 2012*

The Climate and Health Alliance (CAHA) was established in August 2010 and is a coalition of health care stakeholders who wish to see the threat to human health from climate change and ecological degradation addressed through prompt policy action. In its Position Statement in February 2012, CAHA states that:

> *"To date, there is no credible peer reviewed scientific evidence that demonstrates a direct causal link between wind turbines and adverse health impacts in people living in proximity to them. There is no evidence for any adverse health effects from wind turbine shadow flicker or electromagnetic frequency. There is no evidence in the peer reviewed published scientific literature that suggests that there are any adverse health effects from infrasound (a component of low frequency sound) at the low levels that may be emitted by wind turbines."*

The Position Statement explores human perceptions of wind energy and notes that some people may be predisposed to some form of negative perception that itself may cause annoyance. It states that:

> *"Fear and anxious anticipation of potential negative impacts of wind farms can also contribute to stress responses, and result in physical and psychological stress symptoms... Local concerns about wind farms can be related to perceived threats from changes to their place and can be considered a form of "place-protection action", recognised in psychological research about the importance of place and people's sense of identity."*

CAHA notes the existence of *"misinformation about wind power"* and, in particular, states that:

> *"Some of the anxiety and concern in the community stems originally from a self-published book by an anti-wind farm activist in the United States which invented a syndrome, the so-called "wind turbine syndrome". This is not a recognised medical syndrome in any international index of disease, nor has this publication been subjected to peer review."*

CAHA notes that:

> *"Large scale commercial wind farms however have been in operation internationally for many decades, often in close proximity to thousands of people, and there has been no evidence of any significant rise in disease rates."*

This, it states, contrasts with the health effects of fossil fuel energy generation.

6. ***'Wind Turbine Health Impact Study -Report of Independent Expert Panel'*** *– Massachusetts Departments of Environmental Protection and Public Health (2012)*

An expert panel was established with the objective to, inter alia, evaluate information from peer-reviewed scientific studies, other reports, popular media and public comments and to assess the magnitude and frequency of any potential effects and risks to human health associated with the design and operation of wind energy turbines. In its final report, the expert panel set out its conclusions under several headings, including noise and shadow flicker.

In relation to noise, the panel concluded that there was limited or no evidence to indicate any causal link between noise from wind turbines and health effects, including the following conclusions:

> *"There is no evidence for a set of health effects, from exposure to wind turbines that could be characterized as a "Wind Turbine Syndrome."*
>
> *The strongest epidemiological study suggests that there is not an association between noise from wind turbines and measures of psychological distress or mental health problems. There were two smaller, weaker, studies: one did note an association, one did not. Therefore, we conclude the weight of the evidence suggests no association between noise from wind turbines and measures of psychological distress or mental health problems.*
>
> *None of the limited epidemiological evidence reviewed suggests an association between noise from wind turbines and pain and stiffness, diabetes, high blood pressure, tinnitus, hearing impairment, cardiovascular disease, and headache/migraine."*

In relation to shadow flicker, the expert panel found the following:

> *"Scientific evidence suggests that shadow flicker does not pose a risk for eliciting seizures as a result of photic stimulation.*
>
> *There is limited scientific evidence of an association between annoyance from prolonged shadow flicker (exceeding 30 minutes per day) and potential transitory cognitive and physical health effects."*

7. ***Wind Turbines and Health, A Critical Review of the Scientific Literature,*** *Massachusetts Institute of Technology (Journal of Occupational and Environmental Medicine Vol. 56, Number 11, November 2014)*

This review assessed the peer-reviewed literature regarding evaluations of potential health effects among people living in the vicinity of wind turbines. The review posed a number of questions around the effect of turbines on human health, with the aim of determining if stress, annoyance or sleep disturbance occur as a result of living in proximity to wind turbines, and whether specific aspects of wind turbine noise have unique potential health effects. The review concluded the following with regard to the above questions:

- Measurements of low-frequency sound, infrasound, tonal sound emission, and amplitude-modulated sound show that infrasound is emitted by wind turbines. The levels of infrasound at customary distances to homes are typically well below audibility thresholds.

- No cohort or case–control studies were located in this updated review of the peer-reviewed literature. Nevertheless, among the cross-sectional studies of better quality, no clear or consistent association is seen between wind turbine noise and any reported disease or other indicator of harm to human health.
- Components of wind turbine sound, including infrasound and low frequency sound, have not been shown to present unique health risks to people living near wind turbines.
- Annoyance associated with living near wind turbines is a complex phenomenon related to personal factors. Noise from turbines plays a minor role in comparison with other factors in leading people to report annoyance in the context of wind turbines.

A further 25 reviews of the scientific evidence that universally conclude that exposure to wind farms and the sound emanating from wind farms does not trigger adverse health effects, were compiled in September 2015 by Professor Simon Chapman, of the School of Public Health and Sydney University Medical School, Australia, and is included as Appendix 5-1 of this EIAR. Another recent publication by Chapman and Crichton (2017) entitled '*Wind turbine syndrome; A communicated disease'* critically discusses why certain health effects might often be incorrectly attributed to wind turbines.

8. ***Position Paper on Wind Turbines and Public Health:*** *HSE Public Health Medicine Environment and Health Group, February 2017*

The Health Service Executive (HSE) position paper on wind turbines and public health was published in February 2017 to address the rise in wind farm development and concerns regarding potential effects on public health. The paper discusses previous observations and case studies which describe a broad range of health effects that are associated with wind turbine noise, shadow flicker and electromagnetic radiation.

A number of comprehensive reviews conducted in recent years to examine whether these health effects are proven has highlighted the lack of published and high-quality scientific evidence to support adverse effects of wind turbines on health.

The HSE position paper determines that current scientific evidence on adverse effects of wind farms on health is weak or absent. Further research and investigative processes are required at a larger scale in order to be more informative for identifying potential health effects of exposure to wind turbine effects. They advise developers on making use of the Guidelines, as a means of setting noise limits and set back distances from the nearest dwellings.

9. ***Environmental Noise Guidelines for the European Region:*** *World Health Organisation Regional Office for Europe, 2018.*

The WHO Environmental Noise Guidelines provide recommendations for protecting human health from exposure to environmental noise originating from various sources such as transportation noise, wind turbine noise and leisure noise. The Guideline Development Group (GDG) defined priority health outcomes and from this were able to produce guideline exposure levels for noise exposure.

For average noise exposure, the GDG conditionally recommends reducing noise levels produced by wind turbines below 45 dB Lden. The GDG recognise the potential for increased risk of annoyance at levels below this value but cannot determine whether this increase risk can impact health. Wind turbine noise above this level is associated with adverse health effects.

The GDG points out that evidence on health effects from wind turbine noise (apart from annoyance) is either absent or rated low/very low quality. Furthermore, public perception towards wind turbines are hard to differentiate from reported effects related to noise and the two may be inextricably linked. The GDG also recognises that the percentage of people exposed to noise from wind turbines is far lower than other sources such as road traffic and state that any benefit from specifically reducing population exposure to wind turbine noise in all situations remains unclear.

That being said, the GDG recommends renewable energy policies include provisions to ensure noise levels from wind farm developments do not rise above the guideline values for average noise exposure. The GDG also provides a conditional recommendation for the implementation of suitable measures to reduce noise exposure, however, it states that no evidence is available to facilitate the recommendation of one type of intervention over another.

10. ***Infrasound Does Not Explain Symptoms Related to Wind Turbines:*** *Finnish Government's Analysis, Assessment and Research Activities (VN TEAS), 2020*

The study targeted to adverse health effects of wind turbine infrasound and was funded by the Finnish Government's Analysis, Assessment and Research Activities (VN TEAS).

It was found that the low-frequency, inaudible sounds made by wind turbines are not damaging to human health despite fears that they cause unpleasant symptoms. The project, which was carried out over two years, examined the impact of low-frequency—or infrasound—emissions which cannot be picked up by the human ear.

People in many countries have blamed the infrasound waves for symptoms ranging from headaches and nausea to tinnitus and cardiovascular problems, researchers said.

Interviews, sound recordings and laboratory tests were used to explore possible health effects on people living within 20 kilometres (12 miles) of the generators.

The report notes:

> *'...the behavioral findings of the current study suggest that wind turbine infrasound cannot be reliably perceived and it does not result in increased annoyance. Participants that showed health effects did not show signs of increased infrasound sensitivity and did not rate wind turbine sounds more annoying.*

As a result:

> *'These findings do not support the hypothesis that infrasound is the element in turbine sound that causes annoyance. Instead, they suggest that people who have health symptoms which they associate with wind turbine sound are not likely to have these symptoms because they perceive turbine sound more annoying than controls, at least in laboratory settings. It is more likely that these symptoms are triggered by other factors such as symptom expectancy'.*

5.6.3 Turbine Safety

Turbines pose no threat to the health and safety of the general public. The Department of the Environment, Heritage and Local Government (DoEHLG)'s '*Wind Energy Development Guidelines for Planning Authorities 2006*' (referred to as the Guidelines) and the '*Draft Revised Wind Energy Development Guidelines'* (December 2019) (referred to as the draft Guidelines) (iterate that there are no specific safety considerations in relation to the operation of wind turbines. Fencing or other restrictions are not necessary for safety considerations and should be kept to a minimum. People or animals can safely walk up to the base of the turbines.

The Guidelines and the draft Guidelines state that there is a very remote possibility of injury to people from flying fragments of ice or from a damaged blade. Modern turbine blades are composite structures with no bolts or separate components; therefore, danger is minimised. Furthermore, the proposed wind turbines will be fitted with anti-vibration sensors which will detect any imbalance caused by icing of the blades. These sensors will cause the turbine to wait until the blades have been de-iced prior to beginning operation. As such, turbines are designed in such a way that ice throw/projection is not a significant risk. Furthermore, the Site (and the State) falls within the International Energy Agency (IEA) Ice Class 1 Category, which correlates to a *Low* icing frequency.

The International Electrotechnical Commission (IEC) is a global organization that develops and publishes international standards for electrical and electronic technologies. One of the areas where the IEC has played a significant role is in the standardization of wind turbines. The IEC has developed a series of standards specifically for wind turbines, which cover various aspects such as design, testing, and performance. The IEC 61400-1 "Wind turbines – Part 1: Design requirements" provides guidelines and requirements for the design of wind turbines, including considerations for environmental conditions[3]. This standard covers a range of conditions that wind turbines may encounter, including those related to icing. It sets out criteria for the structural design, safety systems, and other aspects to ensure that wind turbines can operate safely and effectively in various environments.[4] As such, the Proposed Project, and like those across Ireland and in many other countries, is generally designed and assessed according to international standards, with the IEC standards being frequently employed in this process. Additionally, regulatory entities and energy authorities at the national level, such as the SEAI, often refer to and align their guidance with internationally recognized standards, including those established by the IEC, such as IEC 61400-1 for wind turbines. In conclusion, the Proposed Project adheres to the criteria specified in both the IEC 61400-1 design requirements and the SEAI guidance.

Turbine blades are manufactured of fiberglass and wood which will prevent any likelihood of an increase in lightning strikes within the Site or the local area. Lightning protection conduits will be integral to the construction of the turbines. Lightning conduction cables, encased in protection conduits, will follow the electrical cable run, from the nacelle to the base of the turbine. The conduction cables will be earthed adjacent to the turbine base. The earthing system will be installed during the construction of the turbine foundations.

5.6.4 Electromagnetic Interference

The provision of underground electric cables of the capacity proposed is common practice throughout the country and installation to the required specification does not give rise to any specific health concerns.

The extremely low frequency (ELF) electric and magnetic fields (EMF) associated with the operation of the proposed cables fully comply with the international guidelines for ELF-EMF set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP), a formal advisory agency to the World Health Organisation, as well as the EU guidelines for human exposure to EMF. Accordingly, there will be no operational impact on properties (residential or other uses) as the ICNIRP guidelines will not be exceeded at any distances even directly above the cables.

The ESB document 'EMF & You' (ESB, 2017)[8] provides further practical information on EMF.

Further details on the potential effects of electromagnetic interference to telecommunications and aviation are presented in Chapter 14: Material Assets.

5.6.5 Effects on Human Health

As set out in the Department of Housing, Planning, Community and Local Government '*Key Issues Consultation Paper on the Transposition of the EIA Directive 2017*' and the guidance listed in Section

[8] *EMF & You: Information about Electric & Magnetic Fields and the electricity network in Ireland Available at:* https://esb.ie/docs/default-source/default-document-library/emf-public-information_booklet_v9.pdf?sfvrsn=0.

1.2.1 of Chapter 1: Introduction, the consideration of the effects on populations and on human health should focus on health issues and environmental hazards arising from the other environmental factors, for example water contamination, air pollution, noise, accidents, disasters.

Chapter 5: Population and Human Health (including Shadow Flicker), Chapter 8: Land, Soils and Geology, Chapter 9: Water, Chapter 10: Air Quality and Chapter 11: Climate, Chapter 12: Noise and Vibration and Chapter 15: Material Assets (Traffic and Transport) provide an assessment of the effects of the Proposed Project on these areas of consideration. There is the potential for negative effects on human health during the wind farm construction phase related to potential emissions to air of dust, potential emissions to land and water of hydrocarbons, release of potentially silt-laden runoff into watercourses and noise emissions.

The Proposed Project design and mitigation measures outlined in Chapter 8 and Chapter 9 ensures that the potential for effects on the water environment are not significant. No effects on local water supplies are anticipated.

As set out in Chapter 9, potential health effects are associated with negative effects on public and private water supplies and potential flooding. The Proposed Wind Farm overlies the Ballingarry groundwater body (GWB). The Kilmanagh gravel aquifer overlies this GWB within the south-eastern portion of the Proposed Wind Farm site and is considered as a separate GWB. The Kimanagh gravels are considered large, thick and clean enough to be classified as a Regionally important gravel (Rg) aquifer. The gravels are considered to supply and form the medium through which bedrock aquifers supply groundwaters to the Callan spring. Chapter 9 Hydrology and Hydrogeology assess the potential for impact on public water supply and private wells during the construction, operation and decommissioning phases.

The detailed Flood Risk Assessment in Appendix 9-1 has also shown that the risk of the Proposed Project contributing to flooding is very low.

A wind farm is not a recognised source of pollution. It is not an activity which requires Environmental Protection Agency licensing under the Environmental Protection Agency Act 1992, as amended. As such, a wind farm is not considered to have ongoing significant emissions to environmental media and the subsequent potential for human health effects.

The Proposed Project is for the development of a renewable energy project, a wind farm, capable of offsetting carbon emissions associated with the burning of fossil fuels. During the operational stage the Proposed Wind Farm will have a long term, significant, positive effect on air quality as set out in Chapter 10 which will contribute to positive effects on human health.

The provision of aviation lighting on permitted turbines is a standard and accepted part of any wind farm development. This is a safety requirement of the Irish Aviation Authority (IAA). The standard lighting required by the IAA are medium intensity lights. Such lighting is designed specifically for aviation safety and is not intended to be overbearing or dominant when viewed from the ground thus striking a reasonable balance between aviation safety and visual effect. The IAA generally only confirm lighting arrangements required for wind farm developments once a consent is in place.

It is considered that aviation lighting on the proposed turbines will have no significant effect on human health, beyond increasing aircraft safety in the context of the Proposed Project. The applicant will continue its engagement with IAA as required in relation to aviation lighting. An assessment of impacts on aviation assets is included in Chapter 15 Material Assets.

The assessments show that the residual effects are not significant and do not have the potential to cause negative health effects for human beings. On this basis, the potential for negative health effects associated with the Proposed Project is imperceptible.

5.6.6 Vulnerability of the Project to Natural Disasters and Major Accidents

As outlined in Section 5.6.5 above, a wind farm is not a recognised source of pollution. Should a major accident or natural disaster occur, the potential sources of pollution onsite during the construction, operational and decommissioning phases, are limited. Sources of pollution with the potential to cause significant environmental pollution and associated negative effects on health, such as bulk storage of hydrocarbons or chemicals, storage of wastes etc., are limited.

In the context of the Proposed Project Site, there is limited potential for significant natural disasters to occur. Ireland is a geologically stable country with a mild temperate climate. The potential natural disasters that may occur are therefore limited to peat instability, flooding and fire. The risk of flooding and potential for contamination of groundwater and drinking water due to the construction of the Proposed Project is addressed in Chapter 9: Hydrology and Hydrogeology, with the risk being limited due to the proposed mitigation measures and site drainage plan, meaning there is limited risk to human health. It is considered that the risk of significant fire occurring, affecting the Proposed Wind Farm and causing the wind farm to have significant environmental effects is limited and therefore a significant effect on human health is similarly limited. As outlined in Chapter 8 of this EIAR, due to the soils upon which the Proposed Wind Farm is not underlain by any peat soils, so there is no risk of peat instability. There are peat soils mapped and observed along the Proposed Grid Connection underground cabling route, however, due to the nature of the proposed works and the fact that the underground cable is to be located fully within the road corridor, there is no risk of peat instability along the Proposed Grid Connection underground cabling route either. As described earlier, there are no significant sources of pollution in the wind farm with the potential to cause environmental or health effects. Also, the spacing of the turbines and distance of turbines from any properties limits the potential for effects on human health. The issue of turbine safety is addressed in Section 5.6.3.

Major industrial accidents involving dangerous substances pose a significant threat to humans and the environment; such accidents can give rise to serious injury to people or serious damage to the environment, both on and off the site of the accident. The Site is not regulated under the Control of Major Accident Hazards Involving Dangerous Substances Regulations i.e. SEVESO sites and so there are no potential effects from this source. A Major Accidents and Natural Disasters assessment is included as Chapter 16.

5.7 Property Values

5.7.1 Property Values and Wind Farms

This section summarises the largest and most recent studies from the United States and the UK and also provides a summary of an Irish working paper by the Centre for Economic Research on Inclusivity and Sustainable (CERIS).

In 2023 CERIS published a working paper entitled *'Wind Turbines and House Prices Along the West of Ireland: A Hedonic Pricing Approach'*.[9] This paper looked at wind turbine developments in Donegal, Leitrim, Sligo, Mayo, Galway, Kerry and Cork and associated property values. This working paper utilised satellite imagery to identify individual turbines and sourced its housing data from www.daft.ie; while the published price on Daft is not equivalent to the final agreed sale price, it was assumed that the listing and transaction prices are correlated. The findings of this research revealed a potential decrease in property values of -14.7% within a 0-1km radius of a wind turbine. However, the sample size of only 225 houses within this range does not adequately represent the broader landscape

[9] *Centre for Economic Research on Inclusivity and Sustainability (2023) Wind Turbines and House Prices Along the West of Ireland: A Hedonic Pricing Approach.* <https://www.universityofgalway.ie/media/researchsites/ceris/files/WP-2023-01.pdf>

of Irish rural housing and the distribution of wind turbines. The author states that there are 'no significant reductions in house prices beyond 1km' and that the effects seen within the 1km band were not persistent and diminished over the operational lifetime of the turbines. Considering that this is a working paper, based on a small sample size where local conditions have the potential to disproportionately impact on the local housing market, further research is required before relying on its findings.

One of the largest studies of the impact of wind farms on property values has been carried out in the United States. 'The Impact of Wind Power Projects on Residential Property Values in the United States: A multi-Site Hedonic Analysis', December 2009, was carried out by the Lawrence Berkley National Laboratory (LBNL) for the U.S Department of Energy. This study collected data on almost 7,500 sales of single-family homes situated within ten miles of 24 existing wind farms in nine different American states over a period of approximately ten years. The conclusions of the study are drawn from eight different pricing models including repeat sales and volume sales models. Each of the homes included in the study were visited to demonstrate the degree to which the wind facility was visible at the time of the sale, and the conclusions of the report state that *"The result is the most comprehensive and data rich analysis to date on the potential impacts of wind energy projects on nearby property values."*

The main conclusion of this study is as follows:

> *"Based on the data and analysis presented in this report, no evidence is found that home prices surrounding wind facilities are consistently, measurably, and significantly affected by either the view of wind facilities or the distance of the home to those facilities. Although the analysis cannot dismiss the possibility that individual or small numbers of homes have been or could be negatively impacted, if these impacts do exist, they are either too small and/or too infrequent to result in any widespread and consistent statistically observable impact."*

This study has been updated by LBNL who published a further paper entitled "A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States", in August 2013. This study analysed more than 50,000 home sales near 67 wind farms in 27 counties across nine U.S. states yet was unable to uncover any impacts to nearby home property values. The homes were all within 10 miles of the wind energy facilities - about 1,100 homes were within 1 mile, with 331 within half a mile. The report is therefore based on a very large sample and represents an extremely robust assessment of the impacts of wind farm development on property values. It concludes that:

> *"Across all model Specifications, we find no statistical evidence that home prices near wind turbines were affected in either the post-construction or post announcement/pre-construction periods."*

The LBNL studies note that their results do not mean that there will never be a case of an individual home whose value goes down due to its proximity to a wind farm – however if these situations do exist, they are considered to be statistically insignificant.

In September 2023, the Energy Policy Journal published 'Commercial wind turbines and residential home values: new evidence from the universe of land-based wind projects in the United States.'[10] This study targeted urban counties in the United Stated with populations over 250,000 persons, and found that on average, after a commercial wind energy project is announced, houses located within 1 mile of a proposed wind energy project experience a decrease in value of 11% relative to homes located within 3-5 miles of the proposed wind energy project. The decline in property values was found to recover post construction with property value impacts becoming relatively small (~2%) and statistically insignificant 9 years or more after project announcement (roughly 5 years after operation begins). This suggests that

[10] *Energy Policy (2023) Commercial wind turbines and residential home values: new evidence from the universe of land-based wind projects in the United States. Available at:* https://www.sciencedirect.com/science/article/pii/S0301421523004226

the housing market is reacting negatively to the expectation of likely impacts (after announcement) and the heightened activity during construction, but after operation begins, those negative perceptions and related home price impacts appear to fade.

The US-based scientific literature on the topic is therefore inconclusive, with the studies summarised above providing contradictory conclusions. The text below summarises the UK studies on the topic.

A study was commissioned by RenewableUK and carried out by the Centre for Economics and Business Research (Cebr) in March 2014. The findings of the study were produced in a report titled '*The effect of wind farms on house prices'* and its main conclusions are:

- Overall, the analysis found that the county-wide property market drives local house prices, not the presence or absence of wind farms.
- The econometric analysis established that construction of wind farms at the five Sites examined across England and Wales has not had a detectable negative impact on house price growth within a five-kilometre radius of the Sites.

A study issued in October 2016 'Impact of wind Turbines on House Prices in Scotland' (2016) was published by Climate Exchange. Climate Exchange is Scotland's independent centre of expertise on climate change which exists to support the Scottish Governments policy development on climate and the transition to a low carbon economy. A copy of the report is included as Appendix 5-2 of this EIAR.

The report presents the main findings of a research project estimating the impact on house prices from wind farm developments. It is based on analysis of over 500,000 property sales in Scotland between 1990 and 2014. The key findings from the study (p.3) are:

- No evidence of a consistent negative effect on house prices: Across a very wide range of analyses, including results that replicate and improve on the approach used by Gibbons (2014), we do not find a consistent negative effect of wind turbines or wind farms when averaging across the entire sample of Scottish wind turbines and their surrounding houses. Most results either show no significant effect on the change in price of properties within 2km or 3km or find the effect to be positive.
- Results vary across areas: The results vary across different regions of Scotland. Our data does not provide sufficient information to enable us to rigorously measure and test the underlying causes of these differences, which may be interconnected and complex.

The UK scientific literature is strong in its conclusions that there are no significant effects on the change in price of properties close to wind farm developments, and that generally the county-wide property market drives local house prices, not the presence or absence of wind farms. This literature is contradictory to the working paper containing the only Irish study on the topic.

The literature described above demonstrates that there is insufficient evidence from the scientific literature and studies conducted to determine that there is the potential for a significant effect on property values as a result of the Proposed Wind Farm.

5.7.2 Property Values and Grid Infrastructure

In May 2016, Eirgrid conducted a literature review and evidence-based field study on the effects of high voltage transmission development on patterns of settlement and land use. The objectives of EirGrid Evidence Based Environmental Studies Study 9: Settlement and land use were to:

- To gather information on patterns of settlement and land use near to existing transmission infrastructure.

- To establish the effects of existing transmission infrastructure on patterns of settlement and land use.
- To review land use planning policy in various Development Plans to determine whether any policy change has arisen as a result of the construction and operation of existing transmission projects.

A literature review of transmission projects from around the world was carried out, including review of Environmental Impact Assessments (EIAs). To investigate effects of transmission projects on patterns of land use and settlement, 31 case studies were chosen; 17 with existing overhead line (OHL) circuits, 10 with substations and 4 in construction. Sites were located in rural, rural/urban and urban areas. Land uses included agricultural, commercial and amenity. Four control Sites had no infrastructure. Coexistence, development density, planning policy and planning application history were all investigated. Planning and land use policy over the last twenty years was reviewed to see if it has influenced, or been influenced, by recent programmes of transmission infrastructure development. This study has established no evidence of any significant impact arising from the construction or existence of transmission infrastructure in terms of patterns of settlement and land use; however, transmission infrastructure can be a local physical constraint on development.

5.8 Residential Amenity

Residential amenity relates to the human experience of one's home, derived from the general environment and atmosphere associated with the residence. The quality of residential amenity is influenced by a combination of factors, including Site setting and local character, land-use activities in the area and the relative degree of peace and tranquillity experienced in the residence.

The Proposed Project is located within a rural setting in County Kilkenny, approximately 8.5km west of Kilkenny City. Land use currently comprises a mix of pastoral agriculture and private forestry. The surrounding land use predominantly comprises pastoral agriculture, and commercial and residential use along local roads and within the settlements of Kilmanagh and Tullaroan. Existing access is via farm entrances off the L-5023 to the west, the L-5024 to the north and the L-1009 to the south.

When considering the amenity of residents in the context of a Proposed Project, there are three main potential impacts of relevance: 1) Shadow Flicker, 2) Noise, and 3) Visual Amenity. Shadow flicker and noise are quantifiable aspects of residential amenity while visual amenity is more subjective. Detailed shadow flicker and noise impact assessments have been completed as part of this EIAR (Section 5.9 refers to shadow flicker, Chapter 12 addresses noise and vibration). A comprehensive landscape and visual impact assessment have also been carried out, as presented in Chapter 14 of this EIAR. Impacts on the local population during the construction, operational and decommissioning phases of the Proposed Project is assessed in relation to each of these key topics and other environmental factors such as noise, traffic, and dust; see impacts in Section 5.10 below. The impact on residential amenity is then derived from an overall judgement of the combination of impacts due to shadow flicker, changes to land-use and visual amenity, noise, traffic, dust and general disturbance.

There are 45 sensitive receptors located within 1 kilometre of the proposed turbine locations. Of these 45 sensitive receptors, 6 no. are involved landowners.

All non-involved sensitive receptors are located at a minimum of 740m from any proposed turbine, i.e., 4 times the tip height of 185m (specifically set out in the draft Guidelines for the purposes of protecting visual amenity). There are 4 no. involved sensitive receptors located between the minimum distance of 500m from any proposed turbine location and 4 times the tip height setback of 740m. The turbine locations adhere to the Guidelines and the draft Guidelines in relation to turbine setback, a minimum 500m set back from sensitive receptors and a minimum setback of four times the tip height of the proposed turbines with a reduced setback of a minimum of 500m for sensitive receptors involved with the Proposed Project.

On the 21st of December 2023, the Department of the Environment, Climate and Communications published the 'Climate Action Plan 2024' (CAP) which states as a key action to publish revised wind energy development guidelines for onshore wind in 2024. Notwithstanding this, however, due to the timelines associated with the planning process for renewable energy projects and the commitment within the CAP to publish revised wind energy development guidelines for onshore wind in 2024, it is possible that the new guidelines may be adopted during the consideration period for the current planning application for the Proposed Wind Farm. Without benefit of the revised wind energy development guidelines for onshore wind, it is considered that since noise emissions and shadow flicker are controllable via inbuilt technologies, the Proposed Wind Farm is capable of compliance with any future guideline limits in this regard. Furthermore, it is considered that 4 times turbine tip height set back from non-involved sensitive receptors has become an industry established accepted separation distance for visual amenity purposes.

5.9 Shadow Flicker Assessment Results

5.9.1 Daily and Annual Shadow Flicker

The WindPRO computer software was used to model the predicted daily and annual shadow flicker levels in significant detail, identifying the predicted daily start and end times, maximum daily duration and the individual turbines predicted to give rise to shadow flicker.

The model results assume worst-case conditions, including:

- 100% sunshine during all daylight hours throughout the year,
- No cloud cover during all daylight hours throughout the year,
- An absence of any screening (vegetation or other buildings),
- That the turbine rotors are facing the property, and
- That the turbine rotors are moving.

The maximum shadow flicker model assumes that daylight hours consist of 100% sunshine. This is a conservative assumption which represents a worst-case scenario. Following the detail provided above on sunshine hours, a sunshine factor of 29.44% has been applied. Taking these probabilities into consideration, an approximation of the 'estimated actual' annual shadow flicker occurrence has been calculated and is presented in Table 5-13.

The predicted maximum daily and annual shadow flicker levels are then considered in the context of the Guidelines daily threshold of 30 minutes per day and annual threshold of 30 hours per year. If there is a predicted exceedance of the threshold limits at any property, the turbines that contribute to the exceedance are also identified.

The Guidelines recommend that shadow flicker at dwellings within 500 metres of a proposed turbine location should not exceed a total of 30 minutes per day or 30 hours per year. As detailed in Section 5.5.1 there are no sensitive receptors less than 500 metres of the proposed turbine locations.

The predicted shadow flicker levels have been modelled for all 164 no. sensitive receptors located within the Shadow Flicker Study Area. The predicted shadow flicker model results indicate:

- 101 sensitive receptors are theoretically predicted to experience zero shadow flicker;
- 63 sensitive receptors are theoretically predicted to experience some shadow flicker;
    - Of the 63 sensitive receptors, 41 sensitive receptors are theoretically predicted to experience shadow flicker that exceeds the Guideline thresholds for daily and/or annual shadow flicker. It should be noted that 5 of these 41 sensitive receptors are involved landowners. Please see Table 5-13 below for details.

- The annual threshold of over 30 hours for shadow flicker (Guidelines) is predicted to be exceeded at 3 sensitive receptors once the regional sunshine average factor of 29.44% has been considered. It should be noted that 1 of these 3 sensitive receptors is an involved landowners.

Figure 5-5 illustrates the houses that are potentially impacted by shadow flicker exceedances from the Proposed Wind Farm.

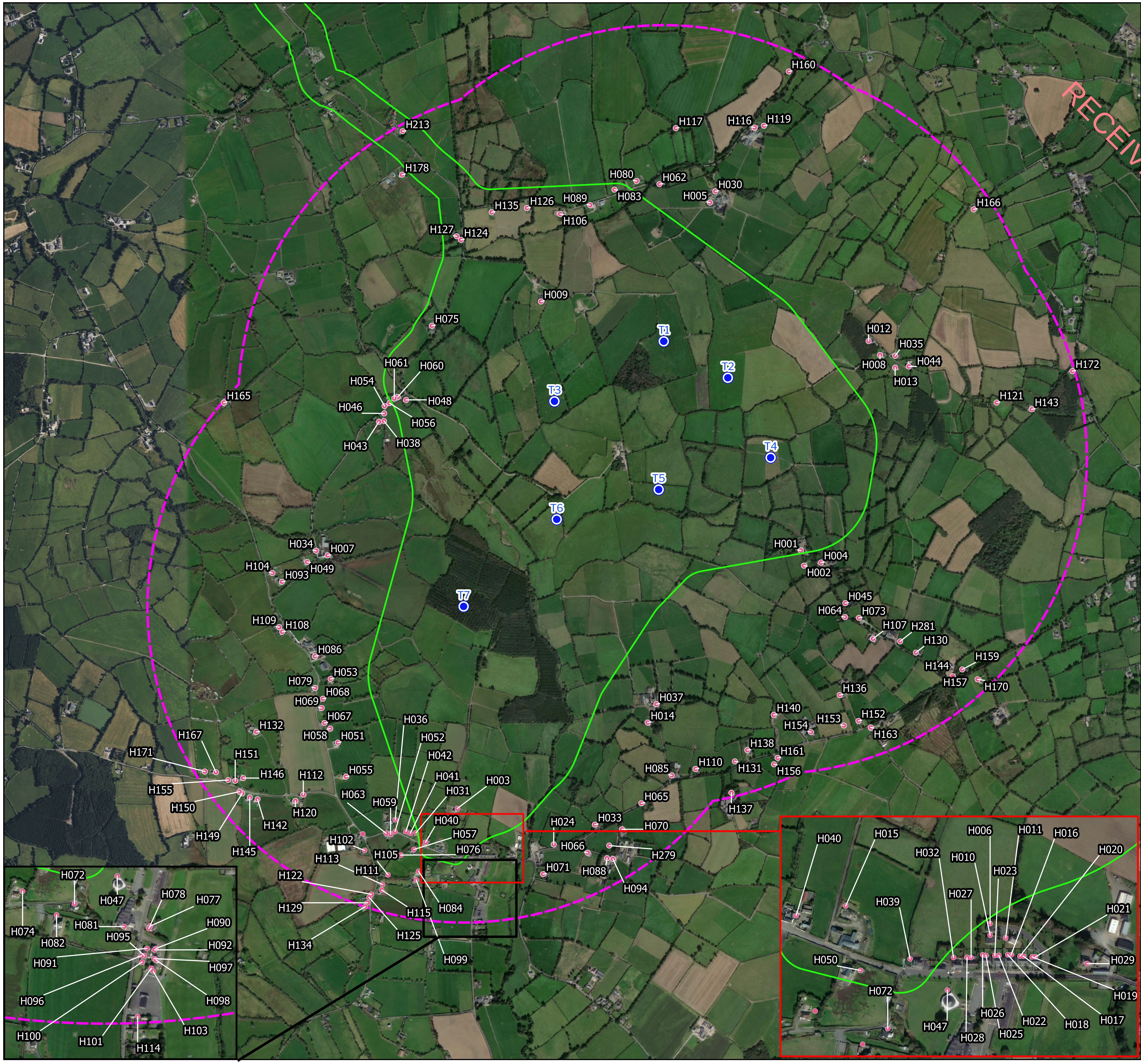
It is worth noting that the predicted exceedances of shadow flicker listed in Table 5-13 is considered conservative and in reality, the occurrence and/or duration of shadow flicker at these properties is likely to be eliminated or significantly reduced as the following items are not considered by the model:

- Receivers may be screened by topography, cloud cover and/or vegetation/built form i.e. adjacent buildings, farm buildings, garages or barns;
- Each receiver will not have windows facing in all directions onto the wind turbines.
- At distances, greater than 500-1000m 'the rotor blade of a wind turbine will not appear to be chopping the light but the turbine will be regarded as an object with the sun behind it. Therefore, it is generally not necessary to consider shadow casting at such distances' (Danish Wind Industry Association, accessed 2010).

Section 5.10.3.2.7 below details the mitigation measures which will be employed at the potentially affected properties to ensure that the current adopted Guidelines are complied with at any property within the Shadow Flicker Study Area. The same mitigation measures (with stricter implementation of shadow flicker controls) also demonstrate that the proposed turbines can be operated in accordance with the shadow flicker requirements of the draft Guidelines, should they be adopted as currently proposed, while the planning application is being determined.

5.9.2 Cumulative Shadow Flicker

The only existing, permitted, or proposed wind farm within 5km of the nearest turbine of the Proposed Project is the existing Foyle wind farm and the permitted but not yet constructed additional turbine that will extend the Foyle wind farm. The rotor diameter for the existing and permitted Foyle wind turbines is 82m with a corresponding shadow flicker study area for these turbines of 820m (10-x rotor diameter). This area does not overlap with the shadow flicker Study Area for the Proposed Project and so there is no potential for cumulative shadow flicker effects in this instance. Due to the separation distance between the proposed turbines and all surrounding proposed, permitted, or operational wind farms, there is no potential for cumulative shadow flicker effects.



Map Legend

- 1.63km Shadow Flicker Study Area
- EIAR Site Boundary
- Proposed Turbines
- Sensitive Receptors

Drawing Title	
Shadow Flicker Study Area	
Project Title	
Briskalagh Renewable Energy Development	
Drawn By MC	**Checked By** EMC
Project No. 230502	**Drawing No.** Figure 5-5
Scale 1:19,000	**Date** 2024-09-09

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Table 9 Maximum Potential Daily & Annual Shadow Flicker – Proposed Briskalagh Renewable Energy Development, Co. Kilkenny.

House ID	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Description	Distance to Nearest Turbine (metres)	Nearest Proposed Turbine No.	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Proposed Turbine(s) Giving Rise to Daly Shadow Flicker Exceedance	Mitigation Strategy Required (Daily)	Mitigation Strategy Required (Annual)
H001*	640797	653926	Dwelling	504	T04	00:51:00	70:51:00	21:06:27	3, 5	Yes	Yes
H002*	640813	653848	Dwelling	583	T04	00:47:00	58:11:00	17:20:02	3, 5	Yes	Yes
H003*	639026	652596	Dwelling	1043	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H004*	640900	653864	Dwelling	600	T04	00:39:00	38:29:00	11:27:53	3, 5	Yes	Yes
H005	640329	655720	Dwelling	754	T01	01:09:00	42:58:00	12:48:02	1, 3	Yes	Yes
H006	639148	652410	Dwelling	1231	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H007	638357	653901	Dwelling	749	T07	00:51:00	68:20:00	20:21:27	6,7	Yes	Yes
H008	641205	654934	Dwelling	773	T04	01:00:00	118:40:00	35:21:10	1, 2, 4, 5	Yes	Yes
H009*	639457	655210	Dwelling	519	T03	01:27:00	142:07:00	42:20:20	1, 2, 3, 4, 5	Yes	Yes
H010	639148	652393	Dwelling	1248	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H011	639171	652389	Dwelling	1254	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H012	641146	655006	Dwelling	750	T02	00:54:00	135:38:00	40:24:27	1, 2, 4, 5	Yes	Yes

House ID	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Description	Distance to Nearest Turbine (metres)	Nearest Proposed Turbine No.	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Proposed Turbine(s) Giving Rise to Daly Shadow Flicker Exceedance	Mitigation Strategy Required (Daily)	Mitigation Strategy Required (Annual)
H013	641283	654869	Dwelling	792	T04	01:05:00	93:45:00	27:55:47	1, 2, 4, 5	Yes	Yes
H014	640007	653039	Dwelling	1122	T07	00:31:00	24:51:00	7:24:12	7	Yes	Yes
H015	638935	652436	Dwelling	1208	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H016	639179	652364	Dwelling	1280	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H017	639197	652362	Dwelling	1284	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H018	639174	652364	Dwelling	1279	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H019	639210	652361	Dwelling	1286	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H020	639192	652362	Dwelling	1283	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H021	639215	652361	Dwelling	1287	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H022	639161	652363	Dwelling	1279	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H023	639155	652363	Dwelling	1279	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H024	639523	652411	Dwelling	1312	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H025	639142	652363	Dwelling	1278	T07	00:00:00	0:00:00	0:00:00	N/A	No	No

House ID	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Description	Distance to Nearest Turbine (metres)	Nearest Proposed Turbine No.	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Proposed Turbine(s) Giving Rise to Daly Shadow Flicker Exceedance	Mitigation Strategy Required (Daily)	Mitigation Strategy Required (Annual)
H026	639137	652364	Dwelling	1277	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H027	639120	652360	Dwelling	1280	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H028	639114	652360	Dwelling	1279	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H029*	639291	652351	Dwelling	1308	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H030	640356	655778	Dwelling	818	T01	00:57:00	28:02:00	8:21:06	1, 3	Yes	Yes
H031*	638813	652471	Dwelling	1193	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H032	639094	652360	Dwelling	1279	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H033	639735	652513	Dwelling	1313	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H034	638298	653925	Dwelling	813	T07	00:46:00	65:46:00	19:35:35	7	Yes	Yes
H035	641283	654930	Dwelling	829	T04	00:58:00	90:42:00	27:01:16	1, 2, 4, 5	Yes	Yes
H036	638706	652538	Dwelling	1155	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H037	640052	653134	Dwelling	1083	T06	00:33:00	31:02:00	9:14:43	7	Yes	Yes
H038	638648	654594	Dwelling	885	T03	00:58:00	75:07:00	22:22:43	1, 3, 6	Yes	Yes

House ID	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Description	Distance to Nearest Turbine (metres)	Nearest Proposed Turbine No.	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Proposed Turbine(s) Giving Rise to Daly Shadow Flicker Exceedance	Mitigation Strategy Required (Daily)	Mitigation Strategy Required (Annual)
H039	639030	652358	Dwelling	1280	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H040*	638862	652422	Dwelling	1232	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H041	638783	652468	Dwelling	1202	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H042	638761	652477	Dwelling	1199	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H043	638622	654590	Dwelling	911	T03	00:56:00	71:07:00	21:11:13	1, 3, 6	Yes	Yes
H044	641353	654875	Dwelling	853	T04	01:00:00	77:39:00	23:08:00	1, 2, 4, 5	Yes	Yes
H045	641026	653655	Dwelling	843	T04	00:23:00	21:13:00	6:19:15	N/A	No	No
H046	638649	654633	Dwelling	880	T03	00:53:00	74:07:00	22:04:50	1, 3, 6	Yes	Yes
H047	639085	652312	Dwelling	1326	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H048	638762	654703	Dwelling	765	T03	00:56:00	96:07:00	28:38:05	1, 3, 6	Yes	Yes
H049	638252	653867	Dwelling	839	T07	00:44:00	57:19:00	17:04:32	7	Yes	Yes
H050	638957	652341	Dwelling	1301	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H051	638410	652936	Dwelling	956	T07	00:00:00	0:00:00	0:00:00	N/A	No	No

House ID	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Description	Distance to Nearest Turbine (metres)	Nearest Proposed Turbine No.	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Proposed Turbine(s) Giving Rise to Daly Shadow Flicker Exceedance	Mitigation Strategy Required (Daily)	Mitigation Strategy Required (Annual)
H052	638705	652477	Dwelling	1214	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H053	638373	653264	Dwelling	781	T07	00:55:00	63:44:00	18:59:14	6, 7	Yes	Yes
H054	638651	654671	Dwelling	876	T03	00:49:00	73:42:00	21:57:23	1, 3, 6	Yes	Yes
H055	638452	652760	Dwelling	1067	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H056	638676	654686	Dwelling	851	T03	00:49:00	78:07:00	23:16:20	1, 3, 6	Yes	Yes
H057	638803	652385	Dwelling	1279	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H058*	638371	653008	Dwelling	933	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H059	638682	652464	Dwelling	1233	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H060	638719	654718	Dwelling	808	T03	00:48:00	86:05:00	25:38:44	1, 3, 6	Yes	Yes
H061	638701	654710	Dwelling	826	T03	00:48:00	82:28:00	24:34:05	1, 3, 6	Yes	Yes
H062	640068	655815	Dwelling	811	T01	00:07:00	0:36:00	0:10:43	N/A	No	No
H063	638659	652468	Dwelling	1236	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H064	641024	653583	Dwelling	907	T04	00:16:00	10:13:00	3:02:37	N/A	No	No

House ID	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Description	Distance to Nearest Turbine (metres)	Nearest Proposed Turbine No.	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Proposed Turbine(s) Giving Rise to Daly Shadow Flicker Exceedance	Mitigation Strategy Required (Daily)	Mitigation Strategy Required (Annual)
H065	639975	652623	Dwelling	1368	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H066	639698	652368	Dwelling	1422	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H067	638341	653037	Dwelling	936	T07	00:08:00	2:41:00	0:47:58	N/A	No	No
H068	638333	653162	Dwelling	868	T07	00:38:00	32:48:00	9:46:18	7	Yes	Yes
H069	638327	653114	Dwelling	900	T07	00:28:00	20:07:00	5:59:35	N/A	No	No
H070	639875	652489	Dwelling	1410	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H071	639468	652258	Dwelling	1440	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H072	638997	652255	Dwelling	1384	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H073	641096	653579	Dwelling	943	T04	00:18:00	13:10:00	3:55:21	N/A	No	No
H074	638890	652281	Dwelling	1368	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H075	638895	655085	Dwelling	742	T03	00:52:00	87:27:00	26:03:10	1, 2, 3,5	Yes	Yes
H076	638734	652356	Dwelling	1323	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H077	639153	652209	Dwelling	1432	T07	00:00:00	0:00:00	0:00:00	N/A	No	No

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H078	639150	652204	Dwelling	1437	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H079	638293	653218	Dwelling	873	T07	00:48:00	54:17:00	16:10:19	6, 7	Yes	Yes
H080	639950	655831	Dwelling	838	T01	00:00:00	0:00:00	0:00:00	N/A	No	No
H081	639099	652208	School	1431	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H082	638960	652232	Dwelling	1410	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H083	639836	655787	Dwelling	823	T01	01:09:00	42:40:00	12:42:40	1, 2	Yes	Yes
H084	638826	652272	Dwelling	1386	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H085	640132	652767	Dwelling	1383	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H086*	638292	653381	Dwelling	809	T07	00:45:00	46:45:00	13:55:39	6, 7	Yes	Yes
H087	638539	652465	Dwelling	1283	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H088	639798	652340	Dwelling	1494	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H089	639711	655707	Dwelling	798	T01	01:27:00	94:25:00	28:07:42	1, 2, 4	Yes	Yes
H090	639165	652163	Dwelling	1479	T07	00:00:00	0:00:00	0:00:00	N/A	No	No

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H091	639146	652163	Dwelling	1478	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H092	639162	652160	Dwelling	1482	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H093	638122	653765	Dwelling	945	T07	00:37:00	24:20:00	7:14:57	7	Yes	Yes
H094	639828	652336	Dwelling	1513	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H095	639141	652148	Dwelling	1492	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H096	639135	652148	Dwelling	1492	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H097	639161	652142	Dwelling	1500	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H098	639165	652139	Dwelling	1503	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H099	638814	652228	Dwelling	1431	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H100	639136	652135	Dwelling	1505	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H101	639155	652122	Dwelling	1519	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H102	638548	652380	Dwelling	1358	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H103	639159	652116	Dwelling	1525	T07	00:00:00	0:00:00	0:00:00	N/A	No	No

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H104	638073	653810	Dwelling	1001	T07	00:34:00	20:49:00	6:12:06	7	Yes	Yes
H105	638669	652254	Dwelling	1438	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H106	639556	655661	Dwelling	846	T01	01:10:00	93:25:00	27:49:49	1, 2	Yes	Yes
H107	641169	653471	Dwelling	1073	T04	00:10:00	5:02:00	1:29:58	N/A	No	No
H108	638123	653507	Dwelling	945	T07	00:34:00	21:24:00	6:22:32	7	Yes	Yes
H109	638108	653531	Dwelling	957	T07	00:34:00	20:28:00	6:05:50	7	Yes	Yes
H110	640254	652800	Dwelling	1453	T05	00:11:00	5:18:00	1:34:44	N/A	No	No
H111	638605	652276	Dwelling	1436	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H112	638232	652668	Dwelling	1274	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H113	638641	652204	Dwelling	1494	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H114	639127	652023	Dwelling	1617	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H115	638636	652176	Dwelling	1522	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H116*	640559	656107	Dwelling	1198	T01	00:00:00	0:00:00	0:00:00	N/A	No	No

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H117	640152	656104	Dwelling	1101	T01	00:00:00	0:00:00	0:00:00	N/A	No	No
H119*	640607	656116	Dwelling	1226	T01	00:00:00	0:00:00	0:00:00	N/A	No	No
H120	638191	652635	Dwelling	1326	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H121	641806	654689	Dwelling	1199	T04	00:31:00	24:19:00	7:14:40	4	Yes	Yes
H122	638583	652154	Dwelling	1558	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H124	639045	655528	Dwelling	962	T03	00:36:00	42:59:00	12:48:20	1, 3	Yes	Yes
H125	638571	652138	Dwelling	1577	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H126	639385	655692	Dwelling	985	T01	00:54:00	53:04:00	15:48:34	1, 2	Yes	Yes
H127	639023	655546	Dwelling	989	T03	00:35:00	40:54:00	12:11:05	1, 3	Yes	Yes
H129	638563	652110	Dwelling	1606	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H130	641390	653400	Dwelling	1254	T04	00:07:00	2:53:00	0:51:32	N/A	No	No
H131	640457	652839	Dwelling	1456	T05	00:05:00	1:17:00	0:22:56	N/A	No	No
H132	637990	652991	Dwelling	1249	T07	00:23:00	19:20:00	5:45:35	N/A	No	No

House ID	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Description	Distance to Nearest Turbine (metres)	Nearest Proposed Turbine No.	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Proposed Turbine(s) Giving Rise to Daly Shadow Flicker Exceedance	Mitigation Strategy Required (Daily)	Mitigation Strategy Required (Annual)
H134	638551	652090	Dwelling	1629	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H135	639203	655670	Dwelling	1027	T03	00:41:00	28:02:00	8:21:06	1, 2	Yes	Yes
H136	640997	653181	Dwelling	1275	T04	00:00:00	0:00:00	0:00:00	N/A	No	No
H137	640439	652677	Dwelling	1608	T05	00:00:00	0:00:00	0:00:00	N/A	No	No
H138	640521	652897	Dwelling	1419	T05	00:00:00	0:00:00	0:00:00	N/A	No	No
H140	640657	653079	Dwelling	1304	T05	00:00:00	0:00:00	0:00:00	N/A	No	No
H142	637996	652644	Dwelling	1455	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H143	641987	654654	Dwelling	1369	T04	00:27:00	18:12:00	5:25:20	N/A	No	No
H144	641502	653340	Dwelling	1370	T04	00:00:00	0:00:00	0:00:00	N/A	No	No
H145	637956	652653	Dwelling	1479	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H146	637922	652753	Dwelling	1441	T07	00:07:00	2:37:00	0:46:46	N/A	No	No
H147	641555	653332	Dwelling	1410	T04	00:00:00	0:00:00	0:00:00	N/A	No	No
H149	637917	652674	Dwelling	1494	T07	00:00:00	0:00:00	0:00:00	N/A	No	No

House ID	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Description	Distance to Nearest Turbine (metres)	Nearest Proposed Turbine No.	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Proposed Turbine(s) Giving Rise to Daly Shadow Flicker Exceedance	Mitigation Strategy Required (Daily)	Mitigation Strategy Required (Annual)
H150	637903	652683	Dwelling	1499	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H151	637881	652739	Dwelling	1482	T07	00:08:00	3:28:00	1:01:58	N/A	No	No
H152	641094	653048	Dwelling	1431	T04	00:00:00	0:00:00	0:00:00	N/A	No	No
H153	641019	653024	Dwelling	1432	T04	00:00:00	0:00:00	0:00:00	N/A	No	No
H154	640849	652990	Dwelling	1431	T04	00:00:00	0:00:00	0:00:00	N/A	No	No
H155	637845	652743	Dwelling	1508	T07	00:11:00	5:30:00	1:38:19	N/A	No	No
H156	640658	652824	Dwelling	1536	T05	00:00:00	0:00:00	0:00:00	N/A	No	No
H157	641580	653278	Dwelling	1467	T04	00:00:00	0:00:00	0:00:00	N/A	No	No
H159	641629	653313	Dwelling	1473	T04	00:00:00	0:00:00	0:00:00	N/A	No	No
H160	640734	656396	Dwelling	1533	T01	00:00:00	0:00:00	0:00:00	N/A	No	No
H161	640677	652857	Dwelling	1513	T05	00:00:00	0:00:00	0:00:00	N/A	No	No
H163	641157	653014	Dwelling	1484	T04	00:00:00	0:00:00	0:00:00	N/A	No	No
H165	637822	654689	Dwelling	1623	T07	00:15:00	4:31:00	1:20:44	N/A	No	No

House ID	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Description	Distance to Nearest Turbine (metres)	Nearest Proposed Turbine No.	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Proposed Turbine(s) Giving Rise to Daly Shadow Flicker Exceedance	Mitigation Strategy Required (Daily)	Mitigation Strategy Required (Annual)
H166	641688	655685	Dwelling	1536	T02	00:21:00	6:54:00	2:03:20	N/A	No	No
H167	637782	652783	Dwelling	1537	T07	00:15:00	10:57:00	3:15:44	N/A	No	No
H170	641708	653262	Dwelling	1564	T04	00:00:00	0:00:00	0:00:00	N/A	No	No
H171	637725	652787	Dwelling	1582	T07	00:13:00	7:11:00	2:08:24	N/A	No	No
H172	642197	654851	Dwelling	1619	T04	00:22:00	6:22:00	1:53:48	N/A	No	No
H178	638741	655864	Dwelling	1408	T03	00:25:00	12:27:00	3:42:33	N/A	No	No
H213	638744	656088	Dwelling	1598	T03	00:00:00	0:00:00	0:00:00	N/A	No	No
H279	639809	652405	Dwelling	1444	T07	00:00:00	0:00:00	0:00:00	N/A	No	No
H281	641309	653458	Dwelling	1159	T04	00:10:00	4:49:00	1:26:06	N/A	No	No

*Involved landowners properties.

5.10 Likely Significant Effects and Associated Mitigation Measures

5.10.1 'Do Nothing' Scenario

If the Proposed Project were not to proceed, the Site will continue to function as it does at present, with no changes made to the current land-use and potential for impacts on population and human health through the construction, operation and decommissioning of the Proposed Project would not occur.

If the Proposed Project were not to proceed, the opportunity to capture part of Kilkenny's valuable renewable energy resource would be lost, as would the opportunity to contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources by 2030 and the reduction of greenhouse gas emissions. The opportunity to generate local employment and investment and to diversify the local economy would also be lost.

5.10.2 Construction Phase

Within this section, the impact will consider the Proposed Project i.e. both the Proposed Wind Farm and the Proposed Grid Connection will be considered as a whole. Where the Proposed Wind Farm and the Proposed Grid Connection are required to be considered separately, this is identified within the assessment.

5.10.2.1 Population

Those working on the construction phase of the Proposed Project will travel daily to the Site from the wider area. The construction phase will have no effect on the population of the area in terms of changes to the population trends or density, household size or age structure.

5.10.2.1.1 *Population Levels*

Pre-Mitigation Impacts

Proposed Wind Farm

Those working on the construction phase of the Proposed Wind Farm will travel daily to the Site from the wider area. The construction phase will have no impact on the population of the area in terms of changes to population trends or density, household size or age structure.

Proposed Grid Connection

Those working on the construction phase of the Proposed Grid Connection will travel daily to the Site from the wider area. The construction phase will have no impact on the population of the area in terms of changes to population trends or density, household size or age structure.

5.10.2.1.2 *Employment and Investment*

Pre-Mitigation Impacts

Proposed Wind Farm

The design, construction, operation and decommissioning of the Proposed Wind Farm will provide employment for technical consultants, contractors and maintenance staff. As discussed, it is proposed to construct the wind farm and grid connection concurrently which would require approximately 100 employees in total, with an estimated 80 jobs focussing on the construction phase of the Proposed Wind Farm. The construction phase of the wind farm will last between 12-18 months.

The Proposed Wind Farm will result in an influx of skilled people into the area, bringing specialist skills for both the construction and operational phases that could result in the transfer of these skills into the local workforce, thereby having a long-term positive effect on the local skills base. Up-skilling and training of local staff in the particular requirements of the wind energy industry is likely to lead to additional opportunities for those staff as additional wind farms are constructed in Ireland. This will have a long-term slight positive indirect effect. Wind Energy Association estimates that there are over 5,000 people employed in roles related to wind energy in Ireland in 2023. This figure is anticipated to grow significantly in the coming years as the race to achieve the targets set out in the Climate Action Plan accelerates.

Proposed Grid Connection

The design, construction and operation of the Proposed Grid Connection will provide employment for technical consultants, contractors and maintenance staff. As discussed, it is proposed to construct the Proposed Wind Farm and Grid Connection concurrently which would require approximately 100 employees in total, with an estimated 20 jobs focusing on the construction phase of the Proposed Grid Connection. Construction of the Grid Connection infrastructure is estimated to last approximately 9 months of the overall 12-18 month construction timeframe. The Proposed Grid Connection will result in an influx of skilled people into the area, bringing specialist skills for both the construction and operational phases that could result in the transfer of these skills into the local workforce, thereby having a long-term positive effect on the local skills base. Up-skilling and training of local staff in the particular requirements of the wind energy industry is likely to lead to additional opportunities for those staff as additional wind farms are constructed in Ireland. This will have a long-term slight positive indirect effect.

Residual Impact

The injection of money in the form of salaries and wages to those employed during the construction phase of the Proposed Project has the potential to result in an increase in household spending and demand for goods and services in the local area. This would result in local retailers and businesses experiencing a short-term positive effect on their cash flow. This will have a short-term slight positive indirect effect.

Significance of Effects

The significance of effects on employment levels and local investment during the construction phase will be slight.

5.10.2.1.3 Land Use Patterns & Activities

Pre-Mitigation Impacts

Proposed Wind Farm

Current land use within the Proposed Wind Farm site comprises agriculture and small scale forestry. Current landuse in the wider landscape comprises of agricultural, commercial, and residential/ commercial activities.

There is no potential for impact on residential and commercial land use in the area. During the construction phase there may be slight interference with agricultural practices where farm practises may be redirected to other fields temporarily.

Proposed Grid Connection

The current land use and activities at the Proposed Grid Connection footprint comprises pastoral agriculture and transport/access along the national, regional and local road network. Within the Proposed Wind Farm site, the Proposed Grid Connection underground electrical cabling route will follow along the existing agricultural track proposed to be upgraded.

Local temporary traffic disruptions are likely along the Proposed Grid Connection underground cabling route; however, once the construction of each element is complete, agricultural practises can return in the areas surrounding the onsite infrastructure and traffic flow will resume as normal along public roads.

The proposed works will be rolling in nature; approx. 100m to 200m will be constructed along the underground cable route at any one time. Potential impacts related to traffic and transport during the construction phase are assessed in Section 5.10.2.2.5 below and in Chapter 15 of this EIAR.

Residual Impact

Due to the small footprint of the above ground elements of the Proposed Project infrastructure, on a site scale and even more so on a local scale, the residual effect is considered negative, direct, slight, permanent impact on land use and a negative, direct, slight short term impact on activities.

Significance of Effects

The effect on land use/activities due to the construction phase the Proposed Project infrastructure is Slight.

5.10.2.1.4 *Property Values*

Pre-Mitigation Impacts

Proposed Wind Farm

As noted in Section 5.7.1 above, the available scientific literature demonstrates that there is insufficient evidence from the scientific literature and studies conducted to determine that there is the potential for a significant effect on property values as a result of the Proposed Wind Farm. The impact assessment on property values outlined below takes a precautionary approach and assumes that based on the inconclusive evidence summarised above in Section 5.7, there is the potential for short-term slight impacts on property values located within 1km of the proposed turbines during the construction phase of the Proposed Wind Farm.

Proposed Grid Connection

As noted in Section 5.7.2 above, the conclusions from available Eirgrid studies indicate that property values (residential and agricultural) show no correlation with the presence of grid infrastructure in the area, with opinions on nearby grid infrastructure diminishing over time. In some cases, property values were demonstrated to increase however, causation with grid infrastructure cannot be determined. There is no potential for impact on property values in the area.

Mitigation and Monitoring Measures

- All mitigation relevant to property values, outlined above and the corresponding chapters: Chapter 10 Air, Chapter 12 Noise and Vibration, Chapter 14 Landscape, and Chapter 15 Material Assets, will be implemented in order to reduce insofar as possible, impacts on property values at properties located in the vicinity of Proposed Wind Farm construction works. Please refer to Chapter 18 Schedule of Mitigation and Monitoring Measures for a full list of measures.
- The Proposed Wind Farm has been designed in accordance with the parameters set out in the Guidelines and with cognisance of the draft Guidelines, adhering to the required setback distances from sensitive receptors set out in those documents.
- The available scientific literature on the topic is inconclusive, with large scale studies conducted in the UK concluding that property values are generally driven by market conditions rather than proximity to wind farms. These studies comprise a much larger sample size than then only Irish study on the topic, a working paper, where the small sample size has the potential to result in individual circumstances having had an outsized bearing on the conclusions drawn from the study.

Residual Impact

It is on this basis that it can be concluded that there is the uncertain potential for a short term negative not significant impact on property values from the construction phase of the Proposed Wind Farm.

Significance of Effects

The effect on property values due to the construction of the Proposed Wind Farm is not significant.

5.10.2.1.5 Tourism

Pre-Mitigation Impact

Proposed Wind Farm

Given that there are currently no tourism attractions specifically pertaining to the Site there are no impacts on tourism associated with the construction phase of the Proposed Wind Farm.

The Proposed Wind Farm site has some rural aesthetic qualities given the relative lack of buildings and infrastructure present on the site. It is mostly agricultural farmland fields defined by vegetated field boundaries, with some areas of forestry; however, these views are common throughout the local area and due to the Proposed Wind Farm sites intensive agricultural land-use, it is noted that the landscape has been subject to substantial levels of human interference and modification. Views from within the Proposed Wind Farm site are generally contained given the surrounding topography and the treelines and hedgerows present on site. With regard to tourist attractions and amenity use surrounding the Proposed Wind Farm site, described in Section 5.4, traffic management safety measures will be in place, where required. Please see below for Traffic impact mitigation measures and Chapter 15 Material Assets for mitigation measures relating to the Proposed Wind Farm site.

Proposed Grid Connection

Given that there are currently no tourism attractions specifically pertaining to the Site there are no impacts on tourism associated with the construction phase of the substation and temporary construction compound. Furthermore, these proposed structures are located on private property therefore no entrance to tourists is currently or will be permitted. There are no tourist attractions located along the Proposed Grid Connection underground cabling route. The Proposed Grid Connection underground cabling route is located within the public road network for the majority of its length, however, tourists seeking to travel to various attractions in the wider landscape during the construction phase, can utilise other routes and therefore will not be significantly impacted by the rolling construction phase of the underground cabling route on the local road network, the N77, R694, or R432. However, should tourists want to utilise portions of any of these roads, the laying of cables will be carried out in a rolling nature at an average rate of 100m to 200m of cabling being installed at any one time. The location of the construction works will be transient in nature with the extent of the section of road closed kept to a minimum.

Mitigation and Monitoring Measures

Section 5.10.2.2.5 below outlines the mitigation measures proposed in relation to traffic management.

Residual Impact

Based on the above it is concluded that there would be a short term, negative imperceptible impact on tourism in the wider landscape due to the construction phase the Proposed Project.

Significance of Effects

The effect on tourism in the wider landscape due to construction phase the Proposed Project is imperceptible.

5.10.2.1.6 *Residential Amenity*

Pre-Mitigation Impact

Proposed Wind Farm

The potential for impacts on residential amenity is discussed in Section 5.8 above. There is the potential for impacts on residential amenity during the construction phase of the Proposed Wind Farm due to air, traffic, noise and vibration emissions due to the presence of additional traffic and plant machinery.

Proposed Grid Connection

There is potential for impacts on residential amenity due to the construction of the Proposed Grid Connection. The Proposed Grid Connection underground cabling route will be located within local roads, two regional roads (R694 and R432) and the N77 national road, with a total length of 22.8 km, this has the potential to give rise to traffic disruptions.

Mitigation and Monitoring Measures

All mitigation as outlined above and the corresponding chapters: Chapter 10 Air Quality, Chapter 12 Noise and Vibration, and Chapter 15 Material Assets will be implemented in order to reduce insofar as possible, impacts on residential amenity at properties located in the vicinity of Proposed Project construction works. Please refer to Chapter 18 Schedule of Mitigation and Monitoring Measures for a full list of measures.

Residual Impact

Based on the above it is concluded that there would be a short-term, negative, slight impact on residential amenity due to the construction phase of the Proposed Project.

Significance of Effects

The effect on residential amenity due to construction phase the Proposed Project is slight.

5.10.2.2 Health

The following impact assessment is produced in accordance with guidance as set out in Section 5.2.2.

5.10.2.2.1 *Health and Safety*

Pre-Mitigation Impacts

Proposed Wind Farm

Construction of the Proposed Wind Farm will necessitate the presence of a construction site and travel on the local public road network to and from the construction site. Construction sites and the machinery used on them pose a potential health and safety hazard to construction workers if site rules are not properly implemented. This will have a short-term potential significant negative impact on health and safety.

Proposed Grid Connection

The construction of the Proposed Grid Connection will include working under existing overhead transmission lines near Ballyragget substation, which may impact on electrical infrastructure and supply in the area and along a local road which may give rise to traffic impacts. Furthermore, working in the cavity of power lines and traffic flow is potential health and safety hazard for construction workers. This will have a short-term potential significant negative impact on health and safety.

Mitigation and Monitoring Measures

The Proposed Project will be constructed in accordance with all relevant Health and Safety Legislation, including:

- Safety, Health and Welfare at Work Act 2005 (No. 10 of 2005);
- Safety, Health and Welfare at Work (General Application) (Amendment) Regulations 2016 (S.I. No. 36 of 2016);
- S.I. No. 528/2021 - Safety, Health and Welfare at Work (Construction) (Amendment) Regulations 2021 and
- Safety, Health and Welfare at Work (Work at Height) Regulations 2006 (S.I. No. 318 of 2006).

The following measures below are also detailed in Chapter 18 Schedule of Monitoring and Mitigation Measures.

- A Health and Safety Plan covering all aspects of the construction process will address the Health and Safety requirements in detail. This will be prepared on a preliminary basis at the procurement stage and developed further at construction stage.
- All hazards will be identified, and risks assessed. Where elimination of the risk is not feasible, appropriate mitigation and/or control measures will be established. The contractor will be obliged under the construction contract and current health and safety legislation to adequately provide for all hazards and risks associated with the construction phase of the project. Safepass registration cards are required for all construction, delivery and security staff. Construction operatives will hold a valid Construction Skills Certificate Scheme card where required. The developer is required to ensure a competent contractor is appointed to carry out the construction

works. The contractor will be responsible for the implementation of procedures outlined in the Safety and Health Plan. Public safety will be addressed by restricting Site access during construction. Fencing will be erected in areas of the Site where uncontrolled access is not permitted.

- Goal posts will be established, where necessary, under overhead electricity lines for the entirety of the construction phase of the Proposed Wind Farm.
- The suitability of machinery and equipment for use near power lines will be risk assessed.
- All staff will be trained on operating voltages of overhead electricity lines running the Site. All staff will be trained to be aware of the risks associated with overhead lines. All contractors that may visit the Sites are made aware of the location of lines before they come on to Site.
- Barriers will run parallel to the overhead line at a minimum horizontal distance of 6 metres on plan from the nearest overhead line conductor wire.
- When activities must be carried out beneath overhead lines, e.g., component delivery or substation construction, a Site-specific risk assessment will be undertaken prior to any works. The risk assessment must take into account the maximum potential height that can be reached by the plant or equipment that will be used prior to any works. Overhead line proximity detection equipment will be fitted to machinery when such works are required.
- Information on safe clearances will be provided to all staff and visitors.
- Signage indicating locations and health and safety measures regarding overhead lines will be erected in canteens and on Site.
- The construction of the Proposed Grid Connection underground cabling will be in phases along the proposed grid route. Prior to commencing grid connection works in the agricultural fields in the townland of Moatpark, goal posts will be established under the 110kV and 38kV overhead lines and remain in place for the duration of the works in this area. The goal posts will not exceed a height of 4.2 metres, unless specifically agreed with ESB Networks
- All staff will be made aware of and adhere to the Health & Safety Authority's 'Guidelines on the Procurement, Design and Management Requirements of the Safety, Health and Welfare at Work (Construction) (Amendment) Regulations 2021'. This will encompass the use of all necessary Personal Protective Equipment and adherence to the Site Health and Safety Plan.

The scale and scope of the project necessitates that a Project Supervisor Design Process (PSDP) and Project Supervisor Construction Stage (PSCS) are required to be appointed in accordance with the provisions of the Health & Safety Authority's *'Guidelines on the Procurement, Design and Management Requirements of the Safety, Health and Welfare at Work (Construction) Regulations 2013'*. The PSDP appointed for the construction stage shall be required to perform his/her duties as prescribed in the Safety, Health and Welfare at Work (Construction) Regulations. These duties include (but are not limited to):

- Identify hazards arising from the design or from the technical, organisational, planning or time related aspects of the project;
- Where possible, eliminate the hazards or reduce the risks;
- Communicate necessary control measures, design assumptions or remaining risks to the PSCS so they can be dealt with in the Safety and Health Plan;
- Ensure that the work of designers is coordinated to ensure safety;
- Organise co-operation between designers;
- Prepare a written Safety and Health Plan;
- Prepare a safety file for the completed structure and give it to the client; and
- Notify the Authority and the client of non-compliance with any written directions issued.

The PSCS appointed for the construction stage shall be required to perform his/her duties as prescribed in the Safety, Health and Welfare at Work (Construction) Regulations. These duties include (but are not limited to):

- Development of the Safety and Health Plan for the construction stage with updating where required as work progresses;
- Compile and develop safety file information.
- Reporting of accidents / incidents;
- Weekly Site meeting with PSCS;
- Coordinate arrangements for checking the implementation of safe working procedures. Ensure that the following are being carried out:
- Induction of all Site staff including any new staff enlisted for the project from time to time;
- Toolbox talks as necessary;
- Maintenance of a file which lists personnel on Site, their name, nationality, current Safe Pass number, current Construction Skills Certification Scheme (CSCS) card (where relevant) and induction date;
- Report on Site activities to include but not limited to information on accidents and incidents, disciplinary action taken and PPE compliance;
- Monitor the compliance of contractors and others and take corrective action where necessary; and
- Notify the Authority and the client of non-compliance with any written directions issued.

Residual Impact

With consideration of the implementation of the detailed mitigation measures there will be a short-term slight negative residual effect on health and safety during the construction phase of the Proposed Project.

Significance of Effects

Based on the assessment above the effects on health and safety during the construction phase of the Proposed Project are considered to be of slight significance.

5.10.2.2.2 *Air Quality: Dust and Exhaust Emissions*

Pre-Mitigation Impacts

Proposed Wind Farm

Potential dust and exhaust emission sources during the construction phase of the Proposed Wind Farm include upgrading of existing access tracks and construction of new access roads, turbine and meteorological mast foundations, temporary construction compound.

An increase in dust and exhaust emissions has the potential to cause a nuisance to sensitive receptors in the immediate vicinity of the Proposed Wind Farm site. The entry and exit of construction vehicles from the Proposed Wind Farm may result in the transfer of mud to the public road, particularly if the weather is wet. This may cause nuisance to residents and other road users. The transport of volumes of stone to be transported into the Proposed Wind Farm site also has the potential to create dust, which could affect nearby sensitive receptors. These effects will have a short-term, slight, negative impact on air quality. The potential dust impacts that may occur during the construction phase of the Proposed Wind Farm are further described in Chapter 10: Air Quality.

Proposed Grid Connection

Potential dust and exhaust emission sources during the construction phase of the Proposed Grid Connection include the construction of a 38kV on-site substation, a temporary construction compound, and the laying of approximately 23km of underground electrical cabling and the road upgrade works which are associated with this process.

The exit via the L5024 to the north of the Site has the potential to result in the transfer of mud to the public road, particularly if the weather is wet. This may cause nuisance to road users and local residents. These impacts will have a short-term, slight, negative impact on air quality. The potential dust impacts may occur at construction phase of the Proposed Wind Farm are further described in Chapter 10 Air Quality.

Mitigation and Monitoring Measures

All mitigation as outlined in Chapter 10 Air Quality will be implemented in order to reduce insofar as possible, impacts on air quality in the vicinity of Proposed Project construction works. Please refer to Chapter 18 Schedule of Mitigation and Monitoring Measures for a full list of measures.

Residual Impacts

With the implementation of the above measures for this construction phase, residual impacts on air quality from dust and exhaust emissions associated with construction activities and machinery are considered to be a short-term slight negative effect on air quality.

Significance of Effects

The effects on air quality from dust and exhaust emissions during the construction phase of the Proposed Project are considered to be slight.

5.10.2.2.3 *Water Quality*

Pre-Mitigation Impacts

Proposed Wind Farm

The construction phase ground works and use of plant on site may give rise to the potential release of suspended solids and hydrocarbons into surface and groundwaters. There are no underground water or sewerage networks at the Proposed Wind Farm infrastructure locations. The Proposed Wind Farm is mapped within the Outer Source Protection Area of the Callan Public Water Supply (PWS). Furthermore, the source protection area associated with the Ballycallan Shale Group Water Scheme (GWS) and the Ballycallan Sand and Gravels GWS are mapped in the very south of the Proposed Wind Farm. Approximately 150m of new proposed road is mapped in this area of the Site. The source protection area associated with the Ballycallan Limestone is mapped ~900m southeast of the Proposed Wind Farm. There are a number of private wells located in the vicinity of the Proposed Wind Farm, and GSI mapping indicates several private boreholes in the area also. Chapter 9 Hydrology and Hydrogeology assesses the potential for impact on group water schemes and other public water supplies during the construction phase. The pre-mitigation impact on water quality is assessed as negative, imperceptible, indirect, long term, unlikely effect on down gradient private water supplies.

Proposed Grid Connection

There are a number of Group Water Schemes located within and in close proximity to the Proposed Grid Connection infrastructure (see Section 9.3.14.1 of this EIAR). The Proposed Grid Connection underground cabling trench depth will only be approximately 1.3m in depth, the excavation will be temporary and transient, and the cable trench will be backfilled with hardcore material. There are 13 no. watercourse crossings located along the Proposed Grid Connection underground cabling route. The proposed onsite 38kV substation is located in approximately 30m from an identified watercourse within the Site. The potential sources of suspended sediment include runoff from spoil excavated from the Proposed Grid Connection infrastructure and entering surface or groundwater systems. The pre-mitigation effect on water quality is assessed as indirect, negative, moderate, temporary, likely effect.

Mitigation and Monitoring Measures

A bespoke drainage design which includes but is not limited to interceptor drains, check dams, swales and ponds will be implemented on the Site. Chapter 9 of this EIAR details all best practice and mitigation measures to minimise the potential for entrainment of suspended sediment or potential hydrocarbon leak. Please see Chapter 9 for details and Chapter 18 for a full list of mitigation and monitoring measures for the Proposed Project.

Residual Impacts

With the implementation of the drainage design and all mitigation measures listed in Chapter 9: Hydrology and Hydrogeology (separation distances, prevailing geology, topography and groundwater flow directions), it is considered that the residual effects are to be short-term, imperceptible, negative effect on water quality.

Significance of Effects

The effects on water quality during the construction phase of the Proposed Project are considered to be imperceptible.

5.10.2.2.4 *Noise and Vibration*

Pre-Mitigation Impacts

Proposed Wind Farm

There will be an increase in noise levels in the vicinity of the Site during the construction phase, as a result of heavy machinery and construction work which has the potential to cause a nuisance to sensitive receptors located closest to the Site. These effects will be short-term in duration. The noisiest construction activities associated with wind farm development are excavation and concrete pouring of the turbine bases. Excavation of a turbine base can typically be completed in five days however, and the main concrete pour is usually conducted within one day.

Construction noise at any given noise sensitive location will be variable throughout the construction project, depending on the activities underway and the distance from the main construction activities to the receiving properties. The potential noise impacts that will occur during the construction phase of the Proposed Wind Farm are further described in Chapter 12: Noise and Vibration. The predicted pre-mitigation noise impacts during the construction of the Proposed Wind Farm are assessed as negative, not significant and short-term.

Proposed Grid Connection

There will be an increase in noise levels in the vicinity of the Site during the construction phase, as a result of heavy machinery and construction work which has the potential to cause a nuisance to sensitive receptors located closest to the Proposed Grid Connection works. These effects will be short-term in duration. The predicted pre-mitigation noise impacts during the construction of the Proposed

Grid Connection and associated infrastructure are assessed as negative, not significant and brief to short-term.

Mitigation and Monitoring Measures

Best practice measures for noise control will be adhered to on-site during the construction phase of the Proposed Project to impacts associated with this phase of the development. Please refer to Chapter 12: Noise and Vibration and Chapter 18 Schedule of Mitigation and Monitoring Measures for a full list of measures.

- No plant used on Site will be permitted to cause an on-going public nuisance due to noise.
- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on Site operations.
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract.
- Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.
- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.
- Any plant, such as generators or pumps, which is required to operate outside of general construction hours will be surrounded by an acoustic enclosure or portable screen where necessary, in particular in locations in close proximity to sensitive receptors.
- During the course of the construction programme, supervision of the works will include ensuring compliance with the limits detailed in Chapter 12 using methods outlined in British Standard BS 5228-1:2014+A1:2019 Code of practice for noise and vibration control on construction and open Sites – Noise.
- The hours of construction activity will be limited to avoid unsociable hours where possible. Construction operations shall generally be restricted to between 7:00hrs and 19:00hrs Monday to Saturday. However, to ensure that optimal use is made of good weather periods or at critical periods within the programme (i.e., concrete pours, large turbine component delivery, rotor/blade lifting) it could occasionally be necessary to work outside of these hours.

Residual Impact

With the implementation of the above mitigation measures, there will be a short-term, slight impact on health due to an increase in noise levels during the construction phase of the Proposed Project.

Significance of Effects

For the reasons outlined above, the effects on human health due to noise emissions from the Proposed Project during construction will be slight.

5.10.2.2.5 *Traffic and Transport*

Pre-Mitigation Impact

Proposed Wind Farm

It is proposed that the large wind turbine components will be delivered from Belview Port, Waterford to the Site via the M9, exiting at Junction 9 onto the N10 heading north, joining the N76, a combined stretch of 22.4km along the national road network. The turbine components will then turn on to the R695 north of Callan, travelling along the regional road for approx. 9.2km, before turning onto the L1009 in Kilmanagh for approx. 150m before reaching the proposed new temporary access road at the south of the Site. All deliveries of turbine components to the Site will follow this route. In addition, deliveries of concrete for the construction of the proposed turbine foundations will also use this temporary access road at the south of the Site. The proposed turbine delivery route is described in further detail in Chapter 4: Description of the Proposed Project. Other non-turbine construction traffic e.g., Heavy Goods Vehicles (HGVs) and Light Goods Vehicles (LGVs) movements involved in the delivery of construction related materials to the Proposed Wind Farm will enter the Proposed Wind Farm site at a new entrance located off the L5024 to the north of the Site.

This will have a temporary slight negative effect on traffic users on the delivery routes.

Proposed Grid Connection

Materials to be used to construct the proposed onsite 38kV substation will be delivered to the Site via the L5024 and will enter from the north via the main construction entrance. This may have a negative temporary effect on existing road users, which will be minimised by the implementation of the mitigation measures included in the traffic management plan.

The Proposed Grid Connection underground cabling works will be completed with a traffic management plan in place and will follow the TII and Eirgrid requirements. The grid route trenches will be excavated in a rolling manner, approx. 100m to 200m per day and backfilled each evening.

By its nature the effects of the traffic volumes associated with the construction of the Proposed Grid Connection and diversions on the network will be transient, will be temporary and will be slight.

Mitigation and Monitoring Measures

A complete Traffic and Transport Assessment (TTA) of the Proposed Project has been carried out by Alan Lipscombe Traffic and Transport Consultants. The full results of the TTA are presented in Chapter 15: Material Assets. The Plan will be developed and implemented to ensure any effect is short term in duration and imperceptible in significance during the construction of the Proposed Project. A Traffic Management Plan has also been developed in order to minimise any potential effect on the local population during the construction phase of the Proposed Project due to traffic. Prior to commencement of any works, the occupants of dwellings in the vicinity of the proposed works will be contacted and the scheduling of works will be made known. Local access to properties will also be maintained throughout any construction works and local residents will be supplied with the number of the works supervisor in order to ensure that disruption will be kept to a minimum. Please refer to Chapter 18 Schedule of Mitigation and Monitoring Measures for a full list of measures.

Residual Effects

Once the Traffic Management Plan is implemented for the construction phase of the Proposed Project, there will be a short-term slight negative residual effect on local road users.

Significance of Effects

Based on the assessment above, the effects on traffic from the Proposed Project during construction will be slight.

5.10.2.2.6 *Major Accidents and Natural Disasters*

Pre-Mitigation Impacts

Proposed Wind Farm

A risk register has been developed which contains all potentially relevant risks identified during the construction phase of the Proposed Wind Farm. Seven risks (Critical Infrastructure Emergencies, Severe Weather, Flooding, Utility Emergencies, Traffic Incident, Contamination, and Fire/Gas Explosion) specific to the construction phase have been identified and are presented in Chapter 16: Major Accidents and Natural Disasters. As outlined in 1.4.1 of this EIAR, the scenario with the highest risk score in terms of the occurrence of major accident and/or disaster during the construction is identified as 'Contamination' of the Site and risk of 'Fire/Explosion' during construction.

Proposed Grid Connection

A risk register has been developed which contains all potentially relevant risks identified during the construction phase of the Proposed Grid Connection. Seven risks (Critical Infrastructure Emergencies, Severe Weather, Flooding, Utility Emergencies, Traffic Incident, Contamination, and Fire/Gas Explosion) specific to the construction phase have been identified and are presented in Chapter 16: Major Accidents and Natural Disasters. The risk register concludes that there is low potential for natural disaster and/or major accident to occur at the Proposed Grid Connection. As outlined in Section 16.4.1 of this EIAR, the scenario with the highest risk score in terms of the occurrence of a major accident and/or disaster during construction is identified as 'Contamination' of the Site and risk of 'Fire/Explosion' during construction.

Residual Impact

The impact assessment concludes that the risk of a major accident and/or disaster during the construction phase of the Proposed Project is considered 'low' in accordance with the '*Guide to Risk Assessment in Major Emergency Management'* (DoEHLG, 2010).

Significance of Effects

Based on the risk assessment in Chapter 16, the effects to/from Major Accidents and Natural Disasters during the construction phase of the Proposed Project is not significant.

5.10.2.2.7 *Shadow Flicker*

Shadow flicker, which occurs during certain weather conditions due to the movement of wind turbine rotor blades, as described in Section 5.2.3 of this chapter, can only occur during the operational phase of a wind energy development. There are therefore no shadow flicker impacts associated with the construction phase of the Proposed Wind Farm or the construction or operational phase of the Proposed Grid Connection. Any shadow flicker effects that occur in the commissioning phase of the proposed turbines will be short in duration and is dealt with under Section 5.10.3.2.7 below.

5.10.3 Operational Phase

5.10.3.1 Population

The effects set out below relate to the operational phase of the Proposed Project.

5.10.3.1.1 *Population Levels*

Pre-Mitigation Impacts

Proposed Wind Farm

The operational phase of the Proposed Project will have no impact on the population of the area with regard to changes to trends, population density, household size or age structure.

Proposed Grid Connection

The operational phase of the Proposed Grid Connection will have no impact on the population of the area with regard to changes to trends, population density, household size or age structure.

Residual Impact

No residual impacts

Significance of Effects

No significance of effects.

5.10.3.1.2 *Employment and Investment*

Pre-Mitigation Impacts

The operational phase will present an opportunity for mechanical-electrical contractors and craftspeople to become involved with the maintenance and operation of the Proposed Project. On a long-term scale, the Proposed Project will create approximately 2-3 jobs during the operational phase relating to the maintenance and control of the Proposed Project, having a long-term slight positive effect.

The injection of money in the form of Community Gain income and landowner payments to the landowners who are participating in the Proposed Project, where a rental agreement has the potential to result in an increase in household spending and demand for goods and services in the local area. This would result in local retailers and businesses experiencing a long-term positive impact on their cash flow. This will have a long-term slight positive indirect effect.

Rates payments for the Proposed Project will contribute significant funds to Kilkenny County Council, which will be redirected to the provision of public services within the county. These services include provisions such as road upkeep fire services, environmental protection, street lighting, footpath maintenance etc. along with other community and cultural support initiatives. This will have a long-term slight positive indirect effect.

Residual Effects

During the operational phase of the Proposed Project there will be long-term slight positive indirect effect on employment and investment.

Significance of Effects

Based on the assessment above, the effects on employment and investment from the Proposed Project during operation will be slight.

Proposed Community Benefit Scheme

Should the Proposed Project receive planning permission, there are substantial opportunities available for the local area in the form of Community Benefit Funds. The value of this fund will be directly proportional to the installed capacity and/or energy produced at the Site and will support and facilitate projects and initiatives including youth, sport and community facilities, schools, educational and training initiatives, and wider amenity heritage and environmental projects. Should the Proposed Project qualify under the Renewable Energy Support Scheme (RESS), a Community Benefit Fund of €2 per megawatt hour will be available to local residents under the Community Benefit Fund. Based on this value, the Proposed Project could generate up to €314,000 for the Community Benefit Fund for the first 15 years of operation of the Proposed Wind Farm. If the Proposed Project does not qualify under RESS, a guaranteed fund of €1 per megawatt hour will be available to locals through the Community Benefit Fund. Based on the guaranteed fund of €1 per megawatt hour , the Proposed Project has the potential to generate up to €137,000 per annum for the Community Benefit Fund for the lifespan of the Proposed Project.

Further details on the proposed Community Gain proposals are presented in Appendix 2-1 and Section 4.9 of Chapter 4 of this EIAR.

5.10.3.1.3 Land Use Patterns and Activities

Pre-Mitigation Impacts

Proposed Wind Farm

The footprint of the Proposed Wind Farm will occupy only a small percentage of the Site; (1.65%) hectares of the overall 1,000-hectare site. Farming practices will not be impacted during the operational phase.

As such, its small-scale relative to the Site and Population Study Area combined with its ability to coexist with ongoing site activities and activities within the landscape indicate that the Proposed Wind Farm will not impact significantly on other land uses within the Site and the wider area.

Proposed Grid Connection

The Proposed Grid Connection's footprint is limited to a small percentage of the Site. During the operational phase, farming practices will resume around the on-site substation and underground electrical cabling route footprint, and traffic movements on the local road network, R694, R432 and N77 will resume as normal. The small scale of the substation relative to the Site, the underground cabling location primarily within the existing road corridor, and its ability to coexist with ongoing site activities and activities within the landscape indicate that the Proposed Grid Connection infrastructure will have no significant impact on other land-uses within the Site and the wider area.

Residual Impact

Due to the small footprint of the Proposed Project infrastructure on a Site scale and even more so on a local scale, the residual effect is considered negative, direct, not significant, permanent effect on land use and activities during the operational phase.

Significance of Effects

The effect on land use/activities due to the operational phase of the Proposed Project will be slight.

5.10.3.1.4 Property Values

Pre-Mitigation Impacts

Proposed Wind Farm

As noted in Section 5.7.1 above, the available scientific literature demonstrates that there is insufficient evidence from the scientific literature and studies conducted to determine that there is the potential for a significant effect on property values as a result of the Proposed Wind Farm. The impact assessment on property values outlined below takes a precautionary approach and assumes that based on the inconclusive evidence summarised above in Section 5.7, there is the potential for short-term slight impacts on property values located within 1km of the proposed turbines during the early operational phase of the Proposed Wind Farm.

Proposed Grid Connection

As noted in Section 5.7.2 above, the conclusions from available Eirgrid studies indicate that property values (residential and agricultural) show no correlation with the presence of grid infrastructure in the area, with opinions on nearby grid infrastructure diminishing over time. In some cases, property values were demonstrated to increase however, causation with grid infrastructure cannot be determined. There is no potential for impact on property values in the area.

Mitigation and Monitoring Measures

- All mitigation relevant to property values, outlined above and the corresponding chapters: Chapter 10 Air, Chapter 12 Noise and Vibration, Chapter 14 Landscape, and Chapter 15 Material Assets, will be implemented in order to reduce insofar as possible, impacts on property values at properties located in the vicinity of Proposed Wind Farm construction works. Please refer to Chapter 18 Schedule of Mitigation and Monitoring Measures for a full list of measures.
- The Proposed Wind Farm has been designed in accordance with the parameters set out in the Guidelines and with cognisance of the draft Guidelines, adhering to the required setback distances from sensitive receptors set out in those documents.
- The available scientific literature on the topic is inconclusive, with large scale studies conducted in the UK concluding that property values are generally driven by market conditions rather than proximity to wind farms. These studies comprise a much larger sample size than then only Irish study on the topic, a working paper, where the small sample size has the potential to result in individual circumstances having had an outsized bearing on the conclusions drawn from the study.
- The available literature that does identify a short-term decrease in property values all note that the decrease in value reduces and becomes statistically insignificant, in general, 5 years after the commencement of the operational phase.

Residual Impact

It can be concluded that there is the potential for a short term negative not significant impact on property values from the operational phase of the Proposed Wind Farm.

Significance of Effects

The effect on property values due to the Proposed Wind Farm is not significant.

5.10.3.1.5 *Tourism*

Pre-Mitigation Effect

Proposed Wind Farm

There are no tourism attractions within or adjacent to the Site that could be affected by the operation of the Proposed Wind Farm. The nearest notable tourist attraction is Ballykeefe Amphitheatre, located within the old Ballykeefe Quarry c.3km southeast of the nearest proposed turbines. There will be no theoretical or actual visibility of the Proposed Project from this location, as outlined in Chapter 14.

Based on the literature review in Section 5.4.3 the majority of studies indicate that wind farm developments do not deter visitors to tourist attractions or scenic landscapes where turbines are visually evident. There are no impacts determined to arise.

Proposed Grid Connection

The Proposed Grid Connection underground cabling route will travel through the public road network and be located underground. There are no tourism attractions located along the Proposed Grid Connection underground cabling route. The nearest notable tourist attraction to the Proposed Grid Connection is Ballykeefe Amphitheatre, located within the old Ballykeefe Quarry. For all potential tourist attractions located along the Proposed Grid Connection underground cable route, there will be no visibility of this element of the proposed Grid Connection during the operational phase and therefore no effects are deemed to arise.

Residual Effects

It is considered that the Proposed Project will have a long-term imperceptible negative impact of visitor experience to attractions in the wider landscape.

Significance of Effects

The effect on tourism in the wider landscape due to the operational phase of the Proposed Project will be imperceptible.

5.10.3.1.6 *Residential Amenity*

Pre-Mitigation Effects

Proposed Wind Farm

Potential impacts on residential amenity during the operational phase of the Proposed Wind Farm could arise primarily due to noise, shadow flicker or changes to visual amenity. Detailed noise and shadow flicker modelling have been carried out as part of this EIAR, which shows that the Proposed Wind Farm will be capable of meeting all required guideline limits in relation to noise and the shadow flicker set out in the Guidelines or the draft Guidelines if adopted. The noise and vibration assessment is detailed in Chapter 12. It should be noted that the Proposed Wind Farm will be brought in line with the noise thresholds imposed on the development by the consenting authority should permission be granted for the Proposed Project. The visual impact of the Proposed Wind Farm is addressed in Chapter 14: Landscape and Visual. The turbine locations have been designed to maximise turbine separation distances to dwellings in the area, with no turbines located within 740 metres of non-involved sensitive receptors, achieving the recommended four times turbine setback, set out in the draft Guidelines specifically for protecting visual amenity.

Proposed Grid Connection

Potential impacts on residential amenity during the operational phase of the proposed substation could arise primarily due to noise and changes to visual amenity. Detailed noise modelling has been carried for the proposed substation, please see below and Chapter 12 Noise and Vibration for details. The visual effects of the 38kV onsite substation and the underground electrical cable have been assessed in Chapter 14 of this EIAR also. The nearest sensitive receptor is located approximately 240m southwest of the proposed onsite substation location and will be further screened by hedgerows and topography. The Proposed Grid Connection electrical cabling route is located underground; therefore, no residential amenity effects are deemed to arise from this element.

Mitigation and Monitoring Measures

- There are no turbines proposed within 740m (4 x tip height) of any third-party sensitive receptors.
- All mitigation measures outlined in Chapter 12 (Noise), shadow flicker (Section 5.9 of this EIAR) and visual (Chapter 14) in this EIAR will be implemented in order to reduce insofar as possible, impacts on residential amenity at properties located within the in the vicinity of the Proposed Project.
- A 2.6m high palisade fence will be erected around the substation which will be painted RAL 6005 (green) to help blend the substation infrastructure in with the surrounding rural landscape.

Please refer to Chapter 18 Schedule of Mitigation and Monitoring Measures for a full list of measures.

Residual Effects

The residual effect is considered to be a negative, moderate, long-term impact on residential amenity.

Significance of Effects

Based on the assessment above there will be a moderate effect on residential amenity during the operational phase.

5.10.3.2 Health

5.10.3.2.1 *Health and Safety*

Pre-Mitigation Effect

Proposed Wind Farm

Rigorous safety checks and continued maintenance are conducted on the turbines and ancillary infrastructure during operational phase to ensure there are no health and safety risks posed by the Proposed Wind Farm. This will have a potential long-term, slight impact on health and safety during the operation phase. Any waste generated at the Site will be managed in accordance the Waste Management Act 1996 and under the relevant EU legislation.

Proposed Grid Connection

Rigorous safety checks and continued maintenance are conducted on the substation and ancillary infrastructure during design, construction, commissioning and operation to ensure the risks posed to staff and landowners are negligible. This will have a potential long-term, slight impact on health and safety during the operation phase.

Mitigation and Monitoring Measures

The following mitigation measures will be implemented during the operation of the Proposed Project to ensure that the risks posed to staff and landowners remain imperceptible throughout the operational life of the Proposed Project. Please refer to Chapter 18 Schedule of Mitigation and Monitoring Measures for a full list of mitigation and monitoring measures for the Proposed Project.

- Access to the turbines is through a door at the base of the structure, which will be locked at all times outside maintenance visits. The doors will only be unlocked as required for entry by authorised personnel and will be locked again following their exit.
- Staff associated with the project will conduct frequent visits, which will include inspections to establish whether any signs have been defaced, removed, faded, or are becoming hidden by vegetation or foliage, with prompt action taken as necessary.
- Signs will also be erected at suitable locations across the Site as required for the ease and safety of operation of the wind farm. These signs include:
- Buried cable route markers at 50m (maximum) intervals and change of cable route direction;
- Directions to relevant turbines at junctions;
- "No access to Unauthorised Personnel" at appropriate locations;
- Speed limits signs at Site entrance and junctions;
- "Warning these Premises are alarmed" at appropriate locations;
- "Danger HV" at appropriate locations;
- "Warning – Keep clear of structures during electrical storms, high winds or ice conditions" at Site entrance;
- "No unauthorised vehicles beyond this point" at specific Site entrances; and
- Other operational signage required as per Site-specific hazards.
- The proposed substation, which will be operated by Eirgrid/ESBN will be locked and fenced off from public access. The substation will be operational remotely and manually 24 hours per day, 7 days a week. Supervisory operational and monitoring activities will be carried out remotely using a SCADA system, with the aid of computers connected via a telephone modem link.
- Periodic service and maintenance work which include some vehicle movement.
- For operational and inspection purposes, substation access is required.
- Servicing of the substation equipment will be carried out in accordance with the manufacturer's specifications, which would be expected to entail the following:
- Six-month service – three-week visit
- Annual service – six-week visit
- Weekly and daily visits as required.

An operational phase Health and Safety Plan will be developed to fully address identified Health and Safety issues associated with the operation of the Site. Access for emergency services will be available at all times.

The components of a wind turbine are designed to last up to 30-35 years and are equipped with a number of safety devices to ensure safe operation during their lifetime. During the operation of the wind farm regular maintenance of the turbines will be carried out by the turbine manufacturer or appointed service company. A project or task specific Health and Safety Plan will be developed for these works in accordance with the Site's health and safety requirements.

Residual Effect

With the implementation of the above mitigation measures, there will be a long-term, imperceptible effect on health and safety during the operational life of the Proposed Project.

Significance of Effects

Based on the assessment above the effects on health and safety during the operational life of the Proposed Project will be imperceptible.

5.10.3.2.2 Noise and Vibration

Pre-Mitigation Effect

Proposed Wind Farm

An assessment of the operational wind turbine noise levels has been undertaken in accordance with best practice guidelines and procedures as outlined in Chapter 12: Noise and Vibration. The predicted noise levels associated with the Proposed Wind Farm will be within best practice noise criteria curves recommended in the Guidelines, therefore, it is not considered that a significant effect is associated with the Proposed Wind Farm.

Proposed Grid Connection

The predicted noise level from the operation of the proposed substation at the nearest sensitive receptor is 24 dB $L_{Aeq,T}$. This level of noise is considered low, and it is concluded that there will be no significant noise emissions from the operation of the proposed substation.

Mitigation and Monitoring Measures

Please see Chapter 12, Section 12.6 for noise and vibration mitigation and monitoring proposals for the Proposed Project. Please refer to Chapter 18: Schedule of Mitigation and Monitoring Measures for a full list of mitigation and monitoring measures for the Proposed Project.

Residual Effects

The predicted residual operational turbine noise effects at the closest noise sensitive locations range from not significant to imperceptible. Please see Chapter 12 Noise and Vibration for details.

Significance of Effects

As stated in the noise assessment in Chapter 12, it has been demonstrated that the relevant national guidance in relation to noise associated with proposed wind turbines can be satisfied. The effects are considered not significant.

5.10.3.2.3 Air Quality: Dust and Exhaust Emissions

Pre-Mitigation Effect

Proposed Wind Farm

The Proposed Wind Farm will require daily visits of maintenance staff in LGVs and will produce dust and other emissions. The Proposed Wind Farm will generate electricity from a renewable source, contributing to a positive impact on air quality. Over the envisaged 35-year lifespan of the Proposed Wind Farm it is expected to effectively reduce carbon dioxide emissions that would have occurred if the same energy were generated by traditional fossil fuel plants. This is a long-term moderate positive effect on Air Quality.

Proposed Grid Connection

The sources of dust and other emissions generated during the operational phase will be from infrequent visits by maintenance staff to the 38kV on-site substation in light good vehicles (LGVs) approximately one or two visits per day. Maintenance of the on-site substation infrastructure may, on occasion, generate of small volumes of dust and exhaust emissions.

Residual Effects

Impacts from dust and other emissions to air from the maintenance of the Proposed Project on sensitive receptors during the operational phase of the Proposed Project is considered to be a momentary and imperceptible effect. Overall, considering offsetting of dust and greenhouse gas emissions from fossil fuels as a result of the Proposed Project, there will be a long-term overall moderate positive effect on Air Quality.

Significance of Effects

Through the offsetting of dust and greenhouse gas emissions from fossil fuels, the Proposed Project is considered have a moderate effect on air quality.

5.10.3.2.4 Water Quality

Pre-Mitigation Impact

Proposed Wind Farm

During the operational phase, all permanent drainage controls will be in place and the disturbance of ground and excavation works will be complete. Some minor maintenance works may be completed, such as maintenance of Site entrances, internal roads and hardstand areas. These works would be of a very minor scale and would be very infrequent. During such maintenance works there is a small risk associated with the release of hydrocarbons from Site vehicles, although it is not envisaged that any significant refuelling works will be undertaken on Site during the operational phase. There will be a long-term imperceptible impact on human health due to water quality.

Proposed Grid Connection

During the operational phase, all permanent drainage controls will be in place and the disturbance of ground and excavation works will be complete. Some minor maintenance works may be completed, such as maintenance of Site entrances, internal roads. These works would be of a very minor scale and would be very infrequent. During such maintenance works there is a small risk associated with the release of hydrocarbons from Site vehicles, although it is not envisaged that any significant refuelling works will be undertaken on Site during the operational phase. There will be a long-term imperceptible impact on human health due to water quality.

Mitigation and Monitoring Measures

The mitigation measures detailed in Chapter 9 Hydrology and Hydrogeology will ensure all surface water runoff from upgraded roads and new road surfaces (including hardstand and turbine base areas) will be captured and treated prior to discharge/release. Settlement ponds, checks dams and buffered outfalls will prevent roads acting as preferential flowpaths by providing attenuation and water quality treatment. Please see Chapter 9 for details. The full list of mitigation and monitoring measures for the Proposed Project are detailed in Chapter 18.

Residual Effects

With the implementation of the Proposed Wind Farm drainage design and mitigation measures the residual effects are considered to be long term imperceptible impact on human health due to water quality.

Significance of Effects

Based on the assessment above, the effects on water quality will be imperceptible.

5.10.3.2.5 *Traffic and Transport*

Pre-Mitigation Effect

Proposed Wind Farm

Major component failures are considered unlikely and therefore the presence of abnormal load vehicles and HGVs at the Site is considered extremely rare. Should a turbine component need replacing, the measures detailed in Section 5.10.2.2.5 and Chapter 15 will be implemented.

All site visits for maintenance and inspection purposes for the Proposed Wind Farm will be done so via LGVs with one or two LGVs each day.

Proposed Grid Connection

Visits to the on-site substation by Eirgrid/ ESBN and/or the Wind Farm operator for maintenance and inspection purposes will be done via LGVs with one or two visits per day.

Residual Effects

Effects on local road users during the operational phase are considered to be a long term negative imperceptible impact.

Significance of Effects

Based on the assessment above, the effects on traffic will be imperceptible.

5.10.3.2.6 *Major Accidents and Natural Disasters*

Pre-Mitigation Effects

Proposed Wind Farm

A risk register has been developed which contains all potentially relevant risks identified during the operational phase of the Proposed Wind Farm. Seven risks (Critical Infrastructure Emergencies, Severe Weather, Flooding, Utility Emergencies, Traffic Incident, Contamination, and Fire/Gas Explosion) specific to the operational phase have been identified and are presented in Chapter 16 Major Accidents and Natural Disasters. As outlined in Section 16.4.1, the scenario with the highest risk score in terms of the occurrence of major accident and/or disaster during operation is identified as "Fire/Explosion' during operation.

Proposed Grid Connection

A risk register has been developed which contains all potentially relevant risks identified during the operational phase of the Proposed Grid Connection. Seven risks (Critical Infrastructure Emergencies, Severe Weather, Flooding, Utility Emergencies, Traffic Incident, Contamination, and Fire/Gas Explosion) specific to the operational phase have been identified and are presented in Chapter 16 Major Accidents and Natural Disasters. The risk register concludes that there is low potential for significant natural disasters to occur at the Proposed Grid Connection. As outlined in Section 16.4.1, the scenario with the highest risk score in terms of the occurrence of major accident and/or disaster during operation is identified as 'Fire/Explosion' during operation.

Residual Effect

The impact assessment concludes that the risk of a major accident and/or disaster during the operational phase of the Proposed Project is considered 'low' in accordance with the '*Guide to Risk Assessment in Major Emergency Management'* (DoEHLG, 2010).

Mitigation and Monitoring Measures

- The Proposed Project will be designed and built in line with current best practice and, as such, mitigation against the risk of major accidents and/or disasters will be embedded through the design. In accordance with the provision of the European Commission '*Guidance on the preparation of Environmental Impact Assessment Reports'* 2017, a Risk Management Plan will be prepared and implemented on site to ensure an effective response to disasters or the risk of accidents. The plan will include sufficient preparedness and emergency planning measures.
- The Proposed Project will also be subject to a fire safety risk assessment in accordance with Chapter 19 of the Safety, Health and Welfare at Work Acts 2005 to 2014, which will assist in the identification of any major risks of fire on site, and mitigation of the same during operation.

Residual Effect

The impact assessment concludes that the risk of a major accident and/or disaster during the operational phase of the Proposed Project is considered 'low' in accordance with the '*Guide to Risk Assessment in Major Emergency Management'* (DoEHLG, 2010).

Significance of Effects

Based on the above and the risk assessment in Chapter 16, the effects to/from Major Accidents and Natural Disasters during the operational phase of the Proposed Project are not significant.

5.10.3.2.7 *Shadow Flicker*

Pre-Mitigation Effect

Proposed Wind Farm

Assuming worst-case conditions, a total of 41 sensitive receptors as a result of the Proposed Wind Farm may experience daily shadow flicker in excess of the Guidelines threshold of 30 minutes per day. The Guidelines total annual guideline limit of 30 hours is predicted to be exceeded at 3 no. sensitive receptors when the regional sunshine average of 29.44% is taken into account. As stated in Section 5.9 there are 164 no. sensitive receptors located within 1.63km of the proposed turbines. Of the 41 no. sensitive receptors predicted to experience daily shadow flicker in excess of the current Guidelines threshold of 30 minutes per day, 5 no. are participating landowners. 36 no. properties may be subject to mitigation measures in order to ensure the Guideline's 30-minute daily and/or 30-hour annual shadow flicker thresholds are not exceeded.

Proposed Grid Connection

There is no potential for the Proposed Grid Connection infrastructure to cause shadow flicker, and so no effect is predicted.

Proposed Mitigation Measures

Where daily or annual shadow flicker exceedances are predicted at any inhabitable or third-party dwelling of the identified 36 no. sensitive receptors, a site visit will be undertaken firstly to determine the presence of existing screening and window orientation at each potentially affected property. This will determine if the receptor has an actual line of sight to any turbine and actual potential for shadow flicker to occur. Once this exercise is completed and all of the potentially affected properties, the following measures will be employed.

Screening Measures

In the event of an occurrence of shadow flicker exceeding guideline threshold values of 30 minutes per day at residential receptor locations, mitigation options will be discussed with the affected homeowner, including:

- Installation of appropriate window blinds in the affected rooms of the residence;
- Planting of screening vegetation;
- Other site-specific measures which might be agreeable to the affected party and may lead to the desired mitigation.

If agreement can be reached with the homeowner, then it would be arranged for the required mitigation to be implemented in cooperation with the affected party as soon as practically possible and for the full costs to be borne by the wind farm operator.

Wind Turbine Control Measures

If it is not possible to mitigate any identified shadow flicker limit exceedance locally using the measures detailed above, wind turbine control measures will be implemented.

Wind turbines can be fitted with shadow flicker control units to allow the turbines to be controlled to prevent the occurrence of shadow flicker at properties surrounding the wind farm. The shadow flicker control units will be added to any required turbines.

A shadow flicker control unit allows a wind turbine to be programmed and controlled using the wind farm's Supervisory Control and Data Acquisition (SCADA) system to change a particular turbine's operating mode during certain conditions or times, or even turn the turbine off if necessary.

All predicted incidents of shadow flicker can be pre-programmed into the wind farm's control software. The wind farm's SCADA control system can be programmed to shut down any particular turbine at any particular time on any given day to avoid excessive shadow flicker occurrences at properties which are not naturally screened or cannot be screened with measures outlined above. Where such wind turbine control measures are to be utilised, they need only be implemented when the specific combined circumstances occur that are necessary to give rise to the shadow flicker effect in the first instance. Therefore, if the sun is not shining on a particular day that shadow flicker was predicted to occur at a nearby property, there would be no need to shut down the relevant turbines that would have given rise to the shadow flicker at the property. Similarly, if the wind speed was below the cut-in speed that caused the turbine rotor to rotate and give rise to a shadow flicker effect at a nearby property, there would be no need to shut down the relevant turbines that otherwise would have caused shadow flicker.

The atmospheric variables that determine whether shadow flicker will occur or not, are continuously monitored at the Proposed Wind Farm and the data fed into the wind farm's SCADA control system. The strength of direct sunlight is measured by way of photocells, and if the sunlight is of sufficient strength to cast a shadow, the shadow flicker control mechanisms come into effect. Wind speed and direction are measured by anemometers and wind vanes on each turbine and on the wind farm's met mast, and similarly, and if wind speed and direction is such that a shadow will be cast, the shadow flicker control mechanisms come into effect. The moving blades of the turbine will require a short period of time to cease rotating and as such there may be a very short period (less than 3 to 5 minutes) during which the blades are slowed to a complete halt. The turbines giving rise to shadow flicker may be turned off on different days to prevent excessive wear and tear on any single turbine.

In order to ensure that the model and SCADA system is accurate and working well a site visit will be carried out to verify the system. The shadow flicker prediction data will be used to select dates on which a shadow flicker event could be observed at one or multiple affected properties and the following process will be adhered to.

1. *Recording the weather conditions at the time of the site visit, including wind speeds and direction (i.e. blue sky, intermittent clouds, overcast, moderate breeze, light breeze, still etc.).*
2. *Recording the house number, time and duration of site visit and the observation point GPS coordinates.*
3. *Recording the nature of the sensitive receptor, its orientation, windows, landscaping in the vicinity, any elements of the built environment in the vicinity, vegetation.*
4. *In the event of shadow flicker being noted as occurring the details of the duration (times) of the occurrence will be recorded.*
5. *The data will then be sent to the wind farm operational team to confirm that the model and SCADA system are working.*
6. *Following 12 months of full operation of the Proposed Project a report can be prepared for the Local Authority describing the shadow flicker mitigation measures used at the wind farm and confirming the implementation and successful operation of the system.*

This method of shadow flicker mitigation has been technically well-proven at wind farms in Ireland and also in areas outside Ireland that experience significantly longer periods of direct sunlight. In order to demonstrate how the SCADA control system can be applied to switch off particular turbines at the relevant times and dates, Table 5-10 below lists the 41 no. sensitive receptors at which a shadow flicker mitigation strategy may be necessary to ensure the Guidelines 30-minute per day shadow flicker threshold is not exceeded. In this case, the relevant turbine(s) would be programmed to switch off for the time required to reduce daily shadow flicker to below the guideline limit of 30 minutes. The SCADA control system would be utilised to control shadow flicker in the absence of being able to agree alternative mitigation measures with the relevant property owner. The mitigation strategy outlined in Table 5-10 below is based on the theoretical precautionary scenario. The details presented in Table 5-10 list the days per year and the turbines that could be programmed to switch off at specific times, in order to reduce daily shadow flicker to a maximum of 28 minutes, which is below the guideline limit of 30 minutes.

Table 10 Shadow Flicker Mitigation Strategy for Daily Shadow Flicker Exceedance – Turbine Numbers and Days

Property No.	Max. Daily shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Turbine(s) Producing Shadow Flicker Exceedance	No. of Days 30min/day Threshold is Exceeded	Days of Year When Mitigation May be Required (Day No's)*	Post-mitigation Maximum Daily Shadow Flicker (hrs:mins:sec)	Post-mitigation Maximum Annual Shadow Flicker (hrs:min:sec)
H001*	00:51:00	21:06:27	3, 5	75	129-165, 181-218	≤00:28:00	≤30:00:00
H002*	00:47:00	17:20:02	3, 5	66	141-206	≤00:28:00	≤30:00:00
H004*	00:39:00	11:27:53	3, 5	38	135-153, 193-211	≤00:28:00	≤30:00:00
H005	01:09:00	12:48:02	1, 3	39	1-10, 338-366	≤00:28:00	≤30:00:00
H007	00:51:00	20:21:27	6,7	48	54-75, 106-107, 240-241, 272-293	≤00:28:00	≤30:00:00
H008	01:00:00	35:21:10	1, 2, 4, 5	127	14-47, 75-103, 244-273,301-334	≤00:28:00	≤30:00:00
H009*	01:27:00	42:20:20	1, 2, 3, 4, 5	149	1-22, 55-89, 259-293, 326-366	≤00:28:00	≤30:00:00
H012	00:54:00	40:24:27	1, 2, 4, 5	163	1-38, 65-98, 249-282, 310-366	≤00:28:00	≤30:00:00
H013	01:05:00	27:55:47	1, 2, 4, 5	96	31-54, 83-106, 241-264, 294-317	≤00:28:00	≤30:00:00
H014	00:31:00	7:24:12	7	15	166-179, 181	≤00:28:00	≤30:00:00
H030	00:57:00	8:21:06	1, 3	31	1-6, 342-366	≤00:28:00	≤30:00:00
H034	00:46:00	19:35:35	7	36	55-72, 276-293	≤00:28:00	≤30:00:00
H035	00:58:00	27:01:16	1, 2, 4, 5	100	24-49, 77-100, 247-270, 298-323	≤00:28:00	≤30:00:00
H037	00:33:00	9:14:43	7	15	144-150, 196-203	≤00:28:00	≤30:00:00
H038	00:58:00	22:22:43	1, 3, 6	69	43-53, 98-120, 227-250, 295-305	≤00:28:00	≤30:00:00
H043	00:56:00	21:11:13	1, 3, 6	65	45-54, 98-119, 227-249, 294-303	≤00:28:00	≤30:00:00
H044	01:00:00	23:08:00	1, 2, 4, 5	79	36-55, 84-102, 245-264, 293-312	≤00:28:00	≤30:00:00
H046	00:53:00	22:04:50	1, 3, 6	69	40-50, 94-116, 231-254, 298-308	≤00:28:00	≤30:00:00
H048	00:56:00	28:38:05	1, 3, 6	90	26-42, 85-112, 235-262, 306-322	≤00:28:00	≤30:00:00
H049	00:44:00	17:04:32	7	32	63-78, 270-285	≤00:28:00	≤30:00:00
H053	00:55:00	18:59:14	6, 7	72	138-209	≤00:28:00	≤30:00:00

Property No.	Max. Daily shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Turbine(s) Producing Shadow Flicker Exceedance	No. of Days 30min/day Threshold is Exceeded	Days of Year When Mitigation May be Required (Day No's)*	Post-mitigation Maximum Daily Shadow Flicker (hrs:mins:sec)	Post-mitigation Maximum Annual Shadow Flicker (hrs:min:sec)
H054	00:49:00	21:57:23	1, 3, 6	67	37-47, 90-111, 236-258, 301-311	≤00:28:00	≤30:00:00
H056	00:49:00	23:16:20	1, 3, 6	72	34-45, 88-111, 236-259, 303-314	≤00:28:00	≤30:00:00
H060	00:48:00	25:38:44	1, 3, 6	80	28-41, 84-108,	≤00:28:00	≤30:00:00
H061	00:48:00	24:34:05	1, 3, 6	78	30-43, 85-109, 238-262, 305-318	≤00:28:00	≤30:00:00
H068	00:38:00	9:46:18	7	38	155-192	≤00:28:00	≤30:00:00
H075	00:52:00	26:03:10	1, 2, 3,5	81	35-63, 79-92, 256-261, 264-267, 284-313	≤00:28:00	≤30:00:00
H079	00:48:00	16:10:19	6, 7	66	141-206	≤00:28:00	≤30:00:00
H083	01:09:00	12:42:40	1, 2	52	1-11, 337-366	≤00:28:00	≤30:00:00
H086*	00:45:00	13:55:39	6, 7	48	118-141, 206-229	≤00:28:00	≤30:00:00
H089	01:27:00	28:07:42	1, 2, 4	73	1-27, 321-366	≤00:28:00	≤30:00:00
H093	00:37:00	7:14:57	7	17	77-85, 263-270	≤00:28:00	≤30:00:00
H104	00:34:00	6:12:06	7	12	75-80, 267-272	≤00:28:00	≤30:00:00
H106	01:10:00	27:49:49	1, 2	91	1-36, 312-366	≤00:28:00	≤30:00:00
H108	00:34:00	6:22:32	7	12	103-108, 239-244	≤00:28:00	≤30:00:00
H109	00:34:00	6:05:50	7	10	101-105, 242-246	≤00:28:00	≤30:00:00
H121	00:31:00	7:14:40	4	8	71-74, 273-276	≤00:28:00	≤30:00:00
H124	00:36:00	12:48:20	1, 3	48	1-6, 50-58, 290-298, 343-366	≤00:28:00	≤30:00:00
H126	00:54:00	15:48:34	1, 2	55	13-39, 308-335	≤00:28:00	≤30:00:00
H127	00:35:00	12:11:05	1, 3	43	1-4, 49-56, 291-298, 344-366	≤00:28:00	≤30:00:00
H135	00:41:00	8:21:06	1, 2	32	30-45, 303-318	≤00:28:00	≤30:00:00

Involved landowners properties

Where a shadow flicker mitigation strategy is to be implemented, it is likely that the control mechanisms would only have to be applied to a turbine to bring the duration of shadow flicker down to the 28-minute post-mitigation shadow flicker target.

Table 5-11 below displays the 3 no. third-party sensitive receptors which are predicted to receive in excess of the Annual Shadow Flicker Limit of 30 hours per year. These properties are also predicted to experience in excess of the Daily Shadow Flicker Limit of 30 minutes per day and are included in the mitigation strategy set out in Table 5-10 above.

Table 11 Shadow Flicker Mitigation Strategy for Annual Shadow Flicker Exceedance

Property No.	Max. Annual Shadow Flicker Adjusted for Regional Sunshine (hrs:min:sec)	Turbine(s) Producing Shadow Flicker Exceedance	Post-mitigation Maximum Daily Shadow Flicker (hrs:mins:sec)
H008	34:56:27	T1, T2, T4, T5	≤30:00:00
*H009	41:50:44	T1, T2, T3, T4, T5	≤30:00:00
H012	39:56:11	T1, T2, T4, T5	≤30:00:00

**Involved landowners properties.*

Overall, the details presented in Table 5-11 demonstrate that using the turbine control system, it will be possible to reduce the level of shadow flicker at any affected property to below the daily guideline limit of 30 minutes, by programming the relevant turbines to switch off at the required dates and times.

Notwithstanding this, the approach set out above should shadow flicker associated with the Proposed Wind Farm be perceived to cause nuisance at any home, the affected homeowner is invited to engage with the Wind Farm operator. Should a complaint or query in relation to shadow flicker be received within 12 months of commissioning of the Proposed Wind Farm, field investigation/monitoring will be carried out by the wind farm operator at the affected property. The homeowner will be asked to log the date, time and duration of shadow flicker events occurring on at least five different days. The provided log will be compared with the predicted occurrence of shadow flicker at the residence, and if necessary, a field investigation will be carried out. Likewise, the Proposed Project can be brought in line with the requirements of the draft Guidelines should they be adopted during the planning application process for this development.

Residual Effect

Following the implementation of the above suite of mitigation measures, the Guidelines limit of 30 mins per day or 30 hours per year will not be exceeded and this will result in a long-term, imperceptible negative residual effect from shadow flicker on human health.

Significance of Effects

Based on the assessment above and the mitigation measures proposed the effects related to shadow flicker will be not significant.

5.10.3.3 Interference with Communications Systems and EMF

Wind turbines, like all large structures, have the potential to interfere with broadcast signals, by acting as a physical barrier or causing a degree of scattering to microwave links. The alternating current, electrical generating and transformer equipment associated with wind turbines, like all electrical equipment, also generates its own electromagnetic fields, and this can interfere with broadcast communications.

EMF is often colloquially considered to have a negative effect on human health. However, as stated in Section 5.6.4 above, the EMF and ELF of electricity cables are in compliance with EU guidelines for the exposure of EMF to humans. As such, there is no potential for negative health effects on the local population due to EMF or ELF produced by any of the proposed infrastructure.

The most significant effect at a domestic level relates to a possible flicker effect caused by the moving rotor, affecting, for example, radio signals. The most significant potential effect occurs where the wind farm is directly in line with the transmitter radio path. This interference can be overcome by the installation of deflectors or repeaters.

Potential impacts on broadcast signals are discussed in detail in Chapter 15 Material Assets. The Proposed Project will have no residual impact on the telecommunications signals of any operator, due to distance from or absence of any links in the area.

5.10.4 Decommissioning Phase

The wind turbines proposed as part of the Proposed Project are expected to have a lifespan of approximately 35 years. Following the end of their useful life, the wind turbines may be replaced with a new set of turbines, subject to planning permission being obtained, or the Proposed Wind Farm may be decommissioned fully. The Proposed Grid Connection (substation and underground cabling) will remain in place as it will form part of the national electricity grid under the control of ESBN / EirGrid.

The works required during the decommissioning phase are described in Section 4.11 in Chapter 4: Description of the Proposed Project. Any effect and consequential effect that occurs during the decommissioning phase will be similar to that which occurs during the construction phase, however to a lesser extent, and the mitigation measures outlined above will be implemented during the decommissioning phase also. A Decommissioning Plan (DP) has been prepared as part of this EIAR and is included as Appendix 4-5. This Decommissioning Plan follows the most up to date NatureScot guidance. By its nature, the DP is a working document and, in accordance with the NatureScot guidance, an updated decommissioning plan will be agreed with the local authorities three months prior to decommissioning the Proposed Project. The principles that will inform the final decommissioning plan are contained in the Construction and Environmental Management Plan (CEMP) in Appendix 4-2.

5.10.5 Cumulative and In-Combination Effects

For the assessment of cumulative effects, any other existing, permitted or proposed projects (wind energy or otherwise) have been considered. The potential cumulative effects of the Proposed Wind Farm, Proposed Grid Connection (together forming the Proposed Project) and other relevant developments has been carried out with the purpose of identifying what influence the Proposed Project will have on the surrounding environment when considered cumulatively.

Further information on projects considered as part of the cumulative assessment are given in Chapter 2: Background to the Proposed Project. The effects with the potential to have cumulative effects on population and human health are discussed below and in more detail in the relevant chapters: noise (Chapter 12), visual effects (Chapter 14) and traffic (Chapter 15).

5.10.5.1 Employment and Economic Activity

Cumulative projects within 20 kilometres of the Proposed Project which may be proposed, permitted or operational/existing contribute to short term employment during the construction stages and provide the potential for long-term employment resulting from maintenance operations. This results in a long-term slight positive effect.

5.10.5.2 Tourism and Amenity

There are no key identified tourist attractions pertaining specifically to the Site.

It is not considered that the Proposed Project together with other projects in the area will cumulatively affect any tourism infrastructure in the wider area. Wind farms are an existing feature in the surrounding landscape, which will assist in the assimilation of the Proposed Project into this environment. As also noted in Section 5.4 above, the conclusions from available research indicate there is a generally positive disposition among tourists towards wind development in Ireland.

It is on this basis that it can be concluded that there would be a long-term imperceptible cumulative effect from the Proposed Project and other wind farm developments in the area.

5.10.5.3 Traffic

Construction of the Proposed Project at the same time as cumulative projects located in the surrounding area has the potential to give rise to cumulative impacts on traffic. In particular, there is a permitted but not yet constructed additional turbine that will extend the existing Foyle wind farm, located approx. 2.5km from the Site, the construction of this turbine, if it occurs at the same time as the Proposed Project has the potential to give rise to cumulative effects on traffic. There is the potential for short-term slight effects to arise as a result of the combination of the construction of the Proposed Project along with nearby cumulative permitted and proposed projects. However, the mitigation measures in relation to traffic set out in Section 5.10.2.2.5 above will ensure that any cumulative effects that arise will be short term in duration and imperceptible in significance

5.10.5.4 Air (Dust)

The nature of the Proposed Project is such that, once operational, it will have a long-term, moderate, positive effect on the air quality.

During the construction phase of the Proposed Project and the construction phase of other developments within 20 kilometres of the wind farm site that are yet to be constructed, there will be minor emissions from construction plant and machinery and potential dust emissions associated with the construction activities. However, once the mitigation proposals, as outlined in Section 10.3.2 of Chapter 10 are implemented during the construction phase of the Proposed Project, there will be no significant cumulative negative effect on air and climate.

The nature of the Proposed Project and other wind energy developments within 20 kilometres are such that, once operational, they will have a cumulative long-term, moderate, positive effect on the air quality and climate.

5.10.5.5 Health and Safety

The Proposed Project will have no effects in terms of health and safety. There is no credible scientific evidence to link wind turbines with adverse health effects. All other existing, permitted or proposed projects (wind energy or otherwise) would be expected to follow all relevant Health and Safety Legislation during the construction, operation and decommissioning phases of the development. It is assumed also that all mitigation measures in relation to the other cumulative projects will also be implemented.

It is on this basis that it can be concluded that there would be a long-term imperceptible cumulative effect from the Proposed Project and other developments in the area.

5.10.5.6 Property Values

As noted in Section 5.10.3.1.4 above, it can be concluded that there is the potential for a short-term negative not significant impact on property values within 1km of the proposed turbines of the Proposed Wind Farm. There are no other cumulative turbines located within 2km of the proposed turbines and so this area within 1km, where there is potential for impacts on property values, will not overlap with any other cumulative turbines. On that basis it is concluded that there is no potential for cumulative effects on property values to arise.

5.10.5.7 Services

The rate payments from the Proposed Project and other projects in the area will contribute significant funds to Kilkenny County Council, which will be redirected to the provision of public services within the County.

In addition, the injection of money into local services though the establishment of community benefit funds is also expected to be a long-term positive cumulative effect.

5.10.5.8 Shadow Flicker

As outlined above, no dwellings may be impacted by shadow flicker from the Proposed Project in combination with other existing, permitted, or proposed wind farms.

5.10.5.9 Residential Amenity

Pre-Mitigation Effects

In the extremely unlikely event that all permitted and proposed projects as described in the cumulative assessment in Chapter 2 are constructed at the same time, there is the potential for a resulting short term, moderate, cumulative, negative effects to occur on residential amenity, in relation to noise and vibration, dust, traffic, telecommunications and visual amenity.

Proposed Mitigation Measures

There are no turbines as part of the Proposed Project that will be located within 740 metres of any third-party sensitive receptors (4 times tip height set back distance set out in the draft Guidelines). All mitigation as outlined under noise and vibration, dust, traffic, visual amenity and telecommunications in this EIAR will be implemented in order to reduce insofar as possible effects on residential amenity at properties located in the vicinity of the Proposed Project works, including along the proposed turbine and construction materials haul route. It is assumed also that all mitigation measures in relation to the other cumulative projects will also be implemented.

Residual Effects

The Proposed Project will have a short-term, slight negative effect on residential amenity during construction works. During the operational phase, noise and shadow flicker from the proposed and permitted projects will be limited to below Guideline levels, resulting in a long-term, not significant residual impact from on residential amenity.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

5.11 Summary

Following consideration of the residual effects (post-mitigation) it is noted that the Proposed Project will not result in any significant effects on human beings in the area surrounding the Proposed Project. Following appropriate mitigation the Guidelines shadow flicker limits will not be exceeded at any property. It is noted that the Proposed Project can be brought in line with the requirements of the draft Guidelines, should they be adopted while this application is in the planning system, through the implementation alteration of the mitigation measures outlined.

Provided that the Proposed Project is constructed, operated and decommissioned in accordance with the design, best practice and mitigation that is described within this EIAR, significant effects on population and human health employment and economic activity, land-use, residential amenity, community facilities and services, tourism, property values and health and safety are not anticipated at international, national or county scale.